Element B

Washington State's Technological Hazard Profiles

Requirement §201.4(c)(2)	[The plan must include] risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments. The risk assessment shall include the following:
§201.4(c)(2)(i)	An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate;
§201.4(c)(2)(ii)	An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;
§201.4(c)(2)(iii)	An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.
§201.4(d)	Plan must be reviewed and revised to reflect changes in development, progress in statewide mitigation efforts, and changes in priorities and resubmitted for approval to the appropriate Regional Administrator every three years.

Technological Hazard Profiles

Requirement §201.4(c)(2)(i) - An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate;

Requirement §201.4(c)(2)(ii) - An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;

Requirement §201.4(c)(2)(iii) - An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

Animal / Crop / Plant Disease and Infestation Outbreak

	Frequency	50+ yrs	10-50 yrs	1-10 yrs	Annually
Animal, Crop, Plant	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
Outbreaks	Hazard scale	< Low to High >			

Risk Level

Frequency – Minor animal/crop/plant disease and infestation outbreaks occur annually in Washington. The potential for severe outbreak in our state is high.

People - The population affected in an animal/crop/plant disease and infestation outbreak in the state could affect more than 1,000 people dead or injured.

Economy – An outbreak could cost our state tens to hundreds of millions of dollars directly and indirectly. International embargos could last years and take decades to recover.

Environment – An animal/crop/plant disease and infestation outbreak can be expected to exceed 10-20% affect of a species or habitat, particularly domesticated species.

Property – Property damage could be in excess of $1 billion dollars in the event of a catastrophic animal/crop/plant disease and infestation outbreak.

HIVA Risk Classification for Infestation is 4A or Mitigation to Reduce Risk is Optional.

Hazard Area Map

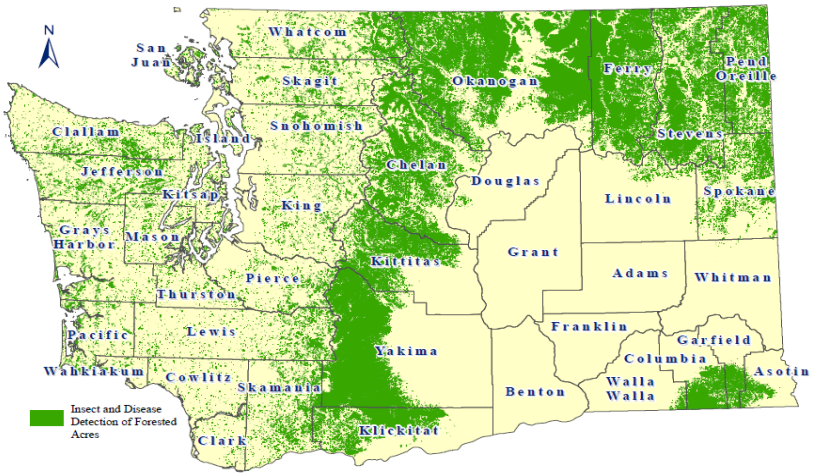


Figure 1 Insect and Disease Detection of Forested Acres in Washington, 1997-2007. Acres were detected via aerial surveillance flown over Washington's forested lands during the summer months of 1997 to 2007.

Summary

The hazard – Agriculture is our state's largest industry. An animal or crop disease outbreak can occur at any time. Animal and crop diseases are endemic in many parts of the world. These diseases can cause widespread devastation of animal populations and crops. Crops are grown year round, processed throughout the state, imported from around the world, and sold nationally and internationally. Animals are raised, traded, sold, and slaughtered year round. Sale barns for livestock hold sales on a regular basis which can move animals throughout the western United States and British Columbia in any 24 hour period. Given rapid movement of trade products nationally and internationally even with strict biosecurity measures, disease outbreaks can still occur. In many cases, diseases may take several days to weeks to manifest resulting in a wider spread outbreak. These animal, crop, plan diseases, and infestation outbreaks primarily pose a danger to our economy since they could result in immediate national and international embargos of Washington State agricultural products.

Perception is reality – In agriculture the perception of safety and wholesomeness of food and food products drives the market. In 2003, one cow was found in Washington with Bovine Spongiform Encephalopathy (BSE or mad cow disease). The beef market for the United States dropped from 18% of the world market to 2% of the market. The United States currently holds about 12% of that market today, and several countries still prohibit U.S. beef and beef products because of the perception of BSE in beef.

Previous occurrences – Animal and crop disease outbreaks occur frequently each year and kill one to two people annually in the Northwest (about 25-35 deaths annually in the U.S.). The 2003 BSE outbreak in Eastern Washington caused immediate international embargos (some which are still in place today) from over 109 countries and an estimated loss to the U.S. beef industry of over $3.5 billion.

Probability of future events – Animal and crop disease outbreaks occur regularly every year in Washington State. Many go unnoticed in the news, but on occasion result in serious illnesses or even death. Because Washington is a national and international leader in many agricultural areas the risk is high for future events.

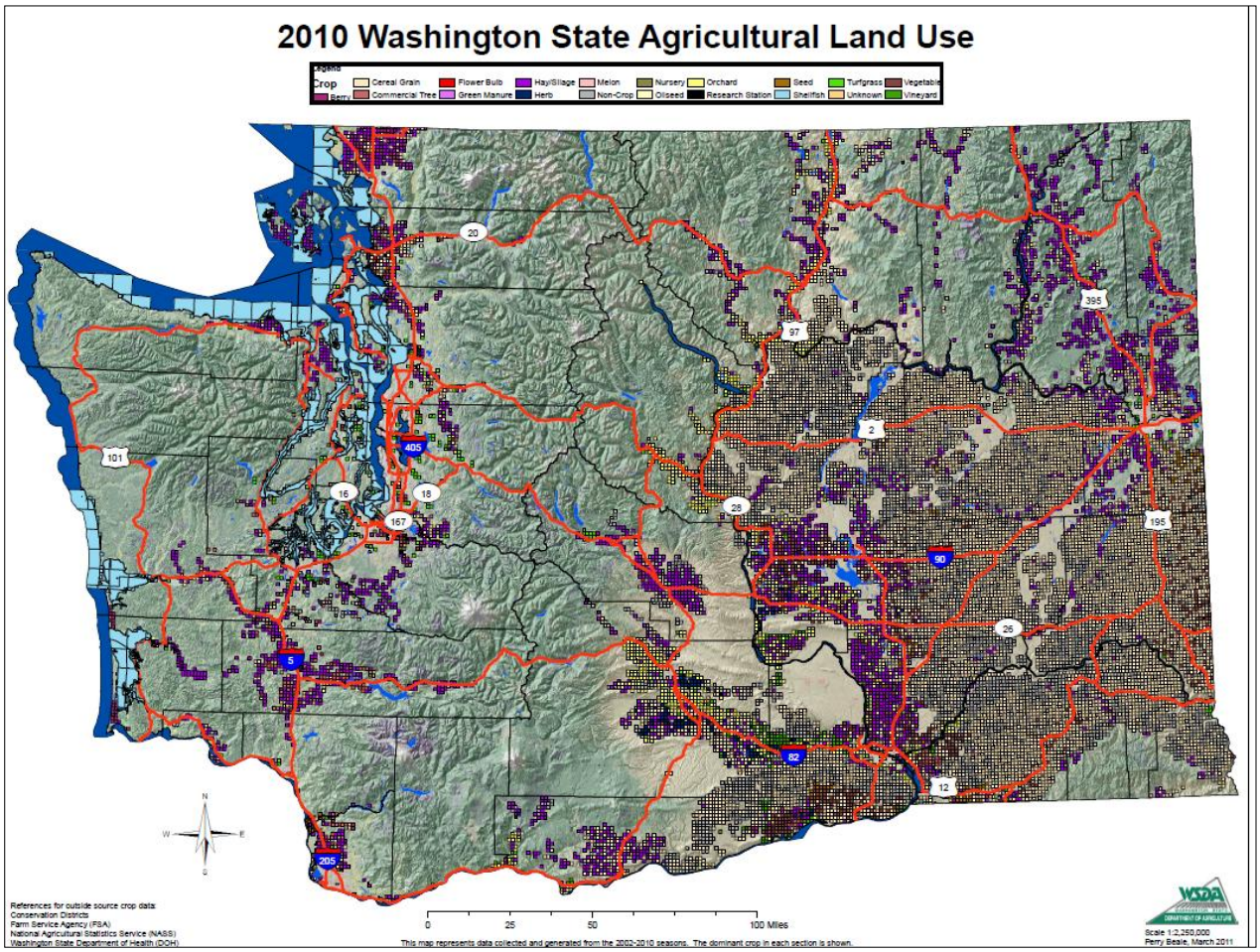
Jurisdictions at greatest risk – All 39 counties in the state are at risk with special attention to eastern Washington counties.

Special note – This profile will not attempt to estimate potential losses to industry facilities due to animal or crop disease outbreaks. However, this hazard profile will identify a number of industries that have a potential for closures due to disease outbreaks.

The Hazard [1] [2] [3] [4]

Rich soils, diverse climates, and large-scale irrigation systems make Washington one of the most productive growing regions in the world and enables farmers to produce some 300 different crops each year. The state's deep-water ports and its proximity to important Asian markets also provide natural advantages for agricultural trade. These ports also ship a significant portion (approximately 30%) of the nation's grain overseas to the Pacific Rim countries.

Figure 2 Washington State Agricultural Land Use. Source: WSDA.



Transboundary Animal Diseases – Those that are of significant economic, trade, and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/management, including exclusion requires cooperation between several countries.

Crop/Plant Diseases – Disease is a natural part of every crop production system. This is true for every crop species and for each type of production system; irrigated versus rain-fed, conventional versus reduced tillage, and continuous versus rotating cropping. Consequently, in any given year, the question is not whether or not disease will occur, but rather which diseases will occur and at what incidence and

severity. Many factors influence disease developments in plants including hybrid/variety genetics, age of the plant at the time of the infection, environment (soil, climate), whether (temperature, rain, wind, hail, etc.), single versus mixed infections, and genetics of the pathogen populations. Due to variation inherent in these factors, diagnosis of plant/crop diseases can be difficult at the early stages of disease on individual plants as well as at the early stages of the epidemic.

Pests **-** Any crop can be threatened by pests. Pests can include, wildlife (birds, rodents, humans, etc.), or insects (moths, beetles, caterpillars, grasshoppers, etc

The state's $40 billion food and agriculture industry employs approximately 160,000 people and contributes 12% percent to the state's economy.

Nearly $13 billion in food and agricultural products were exported through Washington State ports in 2010, the third largest total in the U.S. Our inland ports, barge systems, and rail systems ship over 4.5 million tons of grain annually to Washington State ports for export.

Figure 3 USDA's 2011 National Agricultural Statistics for Washington State. Source: USDA.

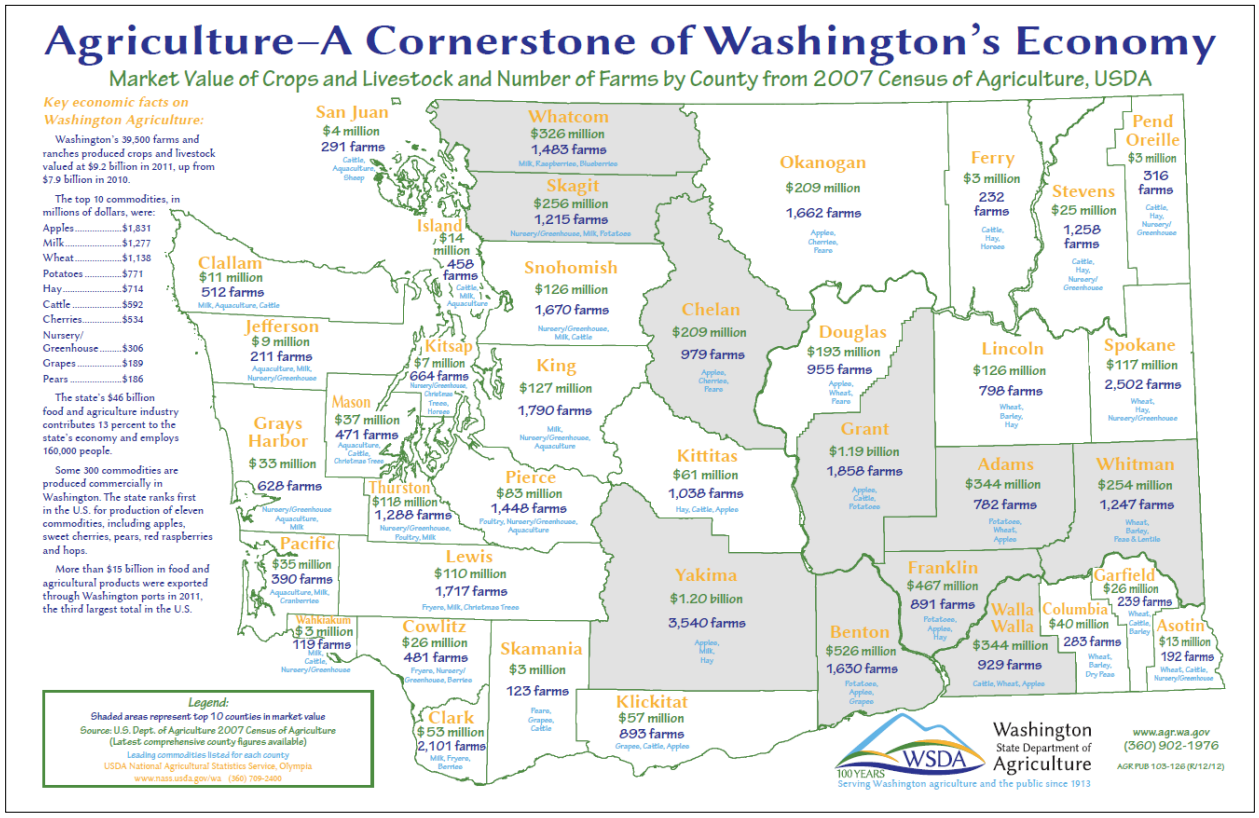


Figure 4 USDA's 2011 National Agricultural Statistics for Washington State. Source: USDA.

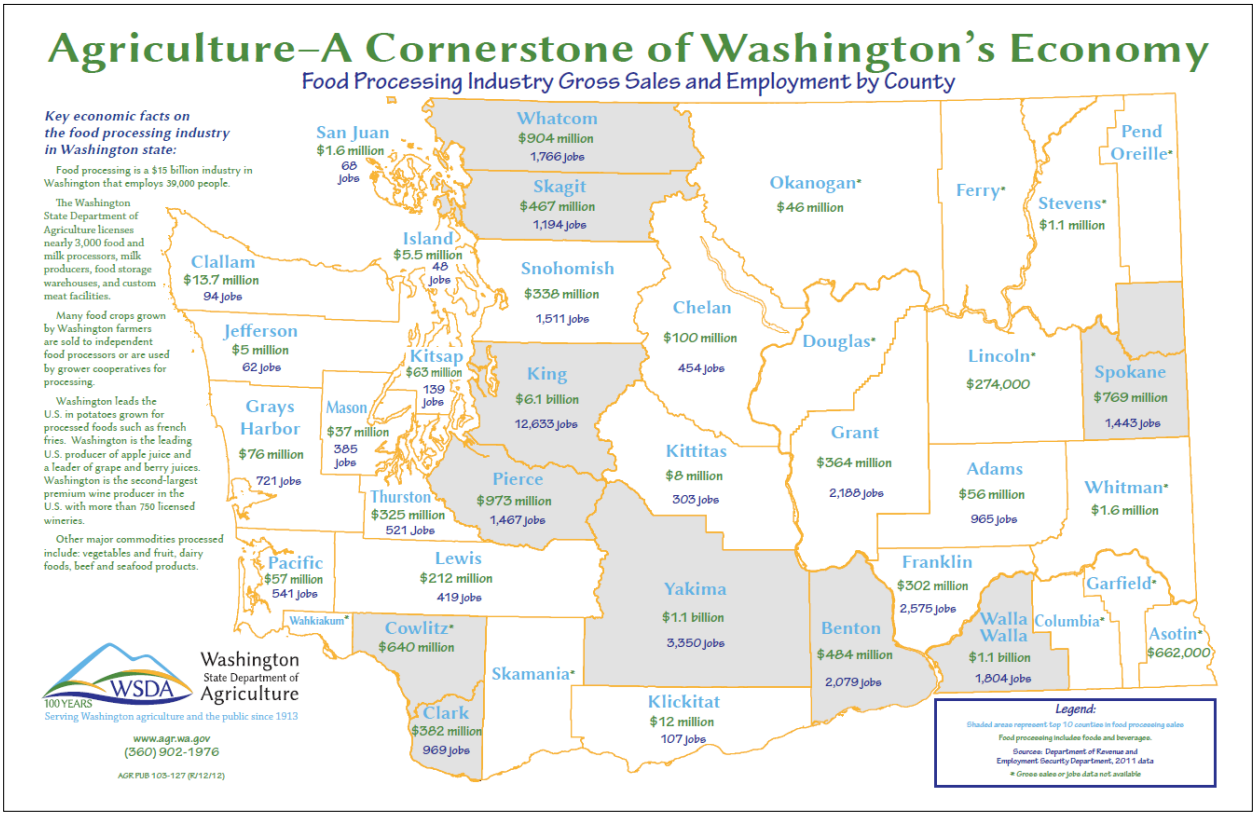


Table 1 Top 10 Commodity	2010 Value of Production (In Millions)
Apples [1]	**$1.440**
Milk	**$ 950**
Wheat	**$ 925**
Potatoes [2]	**$ 654**
Cattle/Calves	**$ 568**
Hay	**$ 509**
Cherries	**$ 367**
Nursery/Greenhouses	**$ 300**
Grapes	**$ 214**
Pears [1]	**$ 189**
Total	**$6,116**

[1] First in U.S. production. [2] Second in U.S. production.

Washington's 39,500 farms power a diverse agricultural economy, led by the state's apple industry with 60 percent of U.S. production. In addition to the top 10 commodities listed below, the Evergreen State is a major producer of potatoes, stone fruits, farm forest products, fish, shellfish, onions, and mint oils.

An outbreak of disease that can be transmitted from animal to animal or plant to plant represents an animal/crop/plant disease. Some disease outbreaks can have a significant public health impacts. Additionally, the animal/crop/plant infestation will likely to have severe economic implications, cause significant crop productions losses, or cause significant environmental damage.

Another means of disease transmission is everyday human activity, unless stringent biosecurity measures are followed. The main vector for the spread of Avian Influenza in British Columbia (2004), Foot and Mouth Disease in the United Kingdom (2001) and South Korea (2011), or gypsy moths in the Pacific Northwest (ongoing) is though everyday activities, such as, routine deliveries, imports of products from overseas, and movement of workers from farm to farm.

The introduction of some high consequence diseases may severely limit or eliminate our ability to move, slaughter, and export animal or animal products. Response and recovery to infectious animal disease outbreaks will be lengthy, and many producers may not be able to return to business. There will be many indirect effects on our economy. Rumors of an infectious animal disease outbreak could cause significant damage to the markets; as was evidenced in the 2003 BSE “Mad Cow” disease outbreak in our state. Markets plummeted and over 109 countries banned import of U.S. beef into their countries, which resulted in over $3.5 billion in losses to the U.S. beef industry.

Crop/plant pest infestations can cause widespread crop/plant loss and severe economic hardship on our state farmers, landowners, and businesses. Once an infestation occurs, the pest may become endemic, causing repeated losses in subsequent growing years. Loss of production will affect all related industries, such as fuel, food, synthetics, processors, etc. in just in Washington State but potentially globally.

Additionally, contamination of food and food products could cause serious damage to Washington’s $13.6 billion food processing industry. The loss in this industry would have a national ripple effect, impacting a number of other states. The food processing industry in Washington employs 37,000 people.

Table 2 lists the 17 most damaging animal diseases while Table 3 lists the 13 most damaging crop diseases.

Table 2 Damaging Animal Diseases		
Disease	Animal industries affected	Public health threat?
Highly pathogenic avian influenza	Poultry	Yes, may be lethal
FMD	Cattle, swine, sheep, and other cloven-hoofed livestock	No
Rift Valley fever	Cattle, sheep	Yes, may be lethal
Exotic Newcastle disease	Poultry	Yes, minor effects
Nipah and Hendra viruses	Swine (Nipah), horses (Hendra)	Yes, may be lethal
Classical swine fever	Swine	No
African swine fever	Swine	No
Bovine spongiform encephalopathy agent	Cattle	Suspected
Rinderpest	Cattle, sheep	No
Japanese encephalitis	Swine, equine	Yes, may be lethal
African horse sickness	Equine	No
Venezuelan equine encephalitis	Equine	Yes, may be lethal
Contagious bovine pleuropneumonia	Cattle	No
Ehrlichia ruminantium (Heartwater)	Cattle, sheep, goats	No
Eastern equine encephalitis	Equine	Yes, may be lethal
Coxiella burnetii	Cattle, sheep, goats	Yes, may be lethal
Akabane	Cattle, sheep, goats	No
Source: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Emergency Management and Diagnostics, National Veterinary Stockpile. http://www.aphis.usda.gov/animal_health/emergency_management/downloads/nvs_basic_brief.pdf		

Table 3 Damaging Crop Diseases			
Plant disease	**Plants affected**	**Route of transmission**	**Impact**
Citrus variegated chlorosis	Sweet oranges and other citrus species	Budding using infected budwood sources, natural root grafts, vectored by xylem feeding insects	The potential economic impact is high because the disease lowers yields, makes fruit unmarketable, and there is a likely loss of domestic and international export markets by embargo.
Downy mildews of corn	Corn, sugarcane, some sorghum cultivars, and many weedy grass species	Spores produced by nearby infected hosts or soil borne over-wintering spores, spread by wind and rain	On sweet corn, losses of 100% have been reported in the Philippines. It was estimated that the national yield loss in the Philippines in the 1974-1975 growing season was $23 million.
Huanglongbing of citrus	All citrus plants, including sweet oranges, tangelos, and mandarins	Grafting with diseased budwood, vectored by citruspsyllids	Severe yield losses result from infections of citrus trees, which usually die in 3 to 8 years. Infected trees produce fruit that is bitter and generally unsuitable for sale as fresh fruit or for juice.

Table 3 Damaging Crop Diseases			
Plant disease	**Plants affected**	**Route of transmission**	**Impact**
Late wilt of corn	Corn	Spread primarily through movement of infested soil, crop residue, or seeds	Corn yield losses approached 40% in Egypt before the introduction of resistant varieties. All areas in the United States could be seriously impacted by the disease, in part, because of favorable environmental conditions.
Laurel wilt of redbay	Trees in the laurel family	Vectored by beetles	The disease poses the greatest threat to the commercial avocado industry. Other economic impact may include decreased property values and lost revenue to nurseries.
Plum pox	Plums, peaches, nectarines, apricots, and almonds	Graft transmission, vectored by aphids	The disease can cause significant economic loss due to a reduction in fruit quality and yield and due to premature tree death. In 1999, the yearly value of production of peaches, nectarines, plums, apricots, and almonds nationally was approximately $1.8 billion.
Potato wart	Potatoes	Infected seed potatoes, movement of fungal spores in soil or water, infested manure from animals that have fed on infected tubers	The economic impact is not from direct disease losses but from loss of international trade markets, long-term quarantines, and regulatory restrictions placed on infested areas and the buffer zones surrounding infested land.
Ralstonia bacterial wilt of potato and geraniums	Various row crops including pepper, tobacco, tomato, and potato, as well as some ornamentals such as geraniums	Primarily a soilborne and waterborne pathogen	The disease is one of the most damaging pathogens on potato worldwide and has been estimated to affect 3.75 million acres in approximately 80 countries with global damage estimates exceeding $950 million per year.
Rathayibacter poisoning	Forage grasses, often resulting in fatal poisoning of grazing animals	Transferred from infested soils into plants by plant parasitic nematodes	Thousands of sheep and cattle, as well as some horses, died from ailments attributed to the disease in Australia, where loss of production and cost of control has been in the millions of dollars.
Red leaf blotch of soybean	Soybeans	Rain splashes the fungus from soil onto leaf surfaces, where germination and infection occur	Yield losses of up to 50% were reported in Zambia and Zimbabwe. The disease could threaten soybean production anywhere in the United States.
Scots pine blister rust	Eurasian pine trees	Spread by windborne spores, may also be carried on plant material	The greatest economic impacts may be to nurseries and Christmas tree plantations that grow Scots pine. Movement restrictions and eradication of infected material could cause enormous economic losses amounting to millions of dollars.
Stem rust of wheat	Wheat and barley	Rain splash and wind-dispersal	The disease has been one of the most important diseases of cereal crops since the emergence of western civilization. Regional epidemics have occurred numerous times in the United States, with losses of over 50% recorded in Minnesota and North Dakota in 1935.
Phytophthora	Forest trees and	Dispersed by splashes,	The potential for the disease to become

Table 3 Damaging Crop Diseases			
Plant disease	**Plants affected**	**Route of transmission**	**Impact**
kernoviae	shrubs such as beech and rhododendron	through contaminated runoff water, in infested soil, and through long-distance dispersal on logs, wood products.	established in U.S. hardwood forests is considered high, as is the likelihood of it causing extensive mortality, therefore, the potential economic and ecological impact to U.S. natural resources due to pathogen establishment is potentially very high.
Source: U.S. Department of Agriculture. www.USDA.gov			

Agricultural infestation is the naturally occurring infection of crops or livestock with insects, vermin, or diseases that render the crops or livestock unfit for consumption or use. Because of Washington State's substantial agricultural industry and related facilities and locations, the potential for infestation of crops or livestock poses a significant risk to the economy of the state. Some level of agricultural infestation is normal for Washington's farmers and ranchers. The concern is when the level of an infestation escalates suddenly, or a new infestation appears, overwhelming normal control efforts. The levels and types of agricultural infestation appear to vary by many factors, including cycles of heavy rains and drought.

One of the key concerns regarding this hazard is the potential introduction of a rapid and economically devastating foreign animal disease, such as foot and mouth disease or bovine spongiform encephalopathy (BSE) disease. Washington State is a large cattle state with over 1 million head produced locally as well as imported. The loss of milk production or beef production would cause economic losses, unemployment etc. to farmers, ranchers, butchers, and other support professions. In 2003, the first confirmed domestic case of BSE disease was reported in Washington State and required quarantining and/or destruction of several herds.

Wheat is susceptible to leaf rust, wheat streak mosaic, barley yellow dwarf virus, strawbreaker, and tan spot. Sorghum losses can occur when a crop is infected with sooty stripe early in the growing season. Gray leaf spot is a growing problem for corn crops.

Infestation is not only a risk to crops in the field, but insect infestation can also cause major losses to stored grain. It is estimated that damage to stored grain by the lesser grain borer, rice weevil, red flour beetle, and rusty grain beetle costs the United States about $500 million annually. The largest infestation ever recorded in North America is the mountain pine beetle in lodge pole pine forests. About 42% of federally threatened and endangered species are at risk primarily because of invasive species.[5]

Previous Occurrences

Table 4 Selected Animal and Crop Disaster Declarations in Washington State, 2002 to Present		
Date	Location	Agricultural Sector Affected/Cause
2002	17 Counties	Crops/Freezing Weather, Drought
2003	Yakima County 32 Counties	Cattle/Bovine Spongiform Encephalopathy (BSE) Crops/Freezing Weather, Drought
2004	Whatcom County 8 Counties	Birds/Avian Influenza Outbreak in adjacent British Columbia – Federal Response Crops/Excessive Rain, Hail, high Winds
2006	2 Counties 23 Counties	Crops/Wild Fires Crops/Severe Storms, Flooding, High Winds
2007	4 Counties	Cattle/Flooding
2007	7 Counties	Crops/Drought
2008	8 Counties	Crops/Freezing Weather
2008	13 Counties	Crops/Drought
2009	6 Counties	Crops/Drought
2009	7 counties	Crops/ Freezing Weather
2010	18 Counties	Crops/Freezing Weather
2010	4 Counties	Crops/Excessive Rain
2010	32 Counties	Crops/Excessive Rain, Freezing Weather
2011	4 Counties	Crops/Freezing Weather
Source: www.USDA.gov		

Probability of Future Events

Determining the probability of future animal and crop disease outbreaks is difficult. There are many factors which influence the probability of future outbreaks. The State's potential risk is elevated by several factors: the large number of products arriving on daily basis at any of our air or sea ports; infected animals coming into our region through sales and shipping containers that may not be known to be on board the vessels; animals being imported for sale (both as pets and as a food source); or the sale of imported agricultural products from other countries. Or infected animals and products can cross the border from neighboring states or British Columbia. Avian diseases could be brought in by birds on their annual migration from Alaska and Canada, or from areas as far south as Mexico or South America. Even travelers to foreign countries who visit agricultural areas may unknowingly transport animal or crop diseases to this country. However, a number of natural and manmade factors can influence future occurrences of animal and crop disease outbreaks:

Weather:

- Extreme weather can affect the existence and spread of animal and crop diseases. Winds can spread Foot and Mouth (FMD) disease up to 35 miles given the right conditions.
- High and low temperatures can set the right conditions for an animal or crop disease to manifest once introduced into the environment.
- Extreme amounts of rain, snow, frost, and drought can make animals and crops vulnerable to disease by weakening their ability to fight off disease.

Accidental Release:

- Farmers, industry, producers, sellers, could accidentally introduce a disease onto a farm, livestock sale yard, processing facility, etc. without knowing it. In the 2003 BSE outbreak, an affected cow entered Washington State as part of a herd from a sale that originated in Canada.
- Infected crops or animals from other countries that are not caught via bio-security screenings or routine inspections during entry into the U.S.

Intentional Release:

An intentional release of an animal or crop disease into the U.S. could easily be carried out via a criminal or terrorist act.

Jurisdictions at the Greatest Risk to Animal and Crop Disease Outbreaks

Every county in the state is potentially vulnerable with central and eastern counties slightly higher due to the higher numbers of large farmlands and larger feedlots. While there are human health implications from infected food supply, it is likely the economic consequences of an agricultural infestation that will be most significant. See Figure 5 below listing the many different sectors in their respective counties within Washington State.

Figure 5 Washington State Crops by County


THE FRESH TASTE OF WASHINGTON
The state's $39 billion food and agriculture industry contributes 12 percent of the state economy and employs 160,000 people.
There are 39,000 farms in Washington state totaling 15.7 million acres. Washington's rich, arable lands are nurtured by a mild climate and a unique growing season, warm days followed by cool nights. The Cascade mountain range creates microclimates that support record crop diversity. Over 330 food, feed, and seed crops are grown each year, more than any other state except California. Washington ranked first in the nation in the production of 12 commodities: apples, pears, sweet cherries, red raspberries, hops, spearmint oil, Lentils, Concord and Niagara grapes, carrots, and sweet corn. A full third of the state is agricultural or rangeland, supporting a large livestock industry. The waters bordering the state to the west support a thriving seafood industry. This natural wealth, combined with the state's proximity to world markets, has made Washington one of the leading exporters of food and agricultural products.
Washington food products are known worldwide for their quality, variety, and year-round availability.
Combined with state-of-the-art food processing, world-class transportation and port facilities, and a cutting-edge research and technology sector, Washington state is an agricultural powerhouse.
WASHINGTON FARM BUREAU
1.800.331.3276
www.wsfb.com
If you are interested in joining a Farm Bureau in your county or want more information on member benefits such as healthcare, safety programs and business services, please call 800-331-3276 or go to www.wsfb.com.
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SKAMANIA
KING
SNOHOMISH
PIERCE
KITTITAS
YAKIMA
KLICKITAT
CHELAN
DOUGLAS
OKANOGAN
GRANT
BENTON
FRANKLIN
WALLA WALLA
COLUMBIA
ADAMS
LINCOLN
FERRY
STEVENS
PEND OREILLE
WHITMAN
GARFIELD
ASOTIN
SPOKANE
GRAIN CORN
GRAPES
GRASS SEED
GREEN PEAS
HAY
HERBS
HOGS
HONEY
HOPS
HORSES
LENTILS
MILK
MINK
MINT
MUSHROOMS
NURSERY
NECTARINES
OATS
ONIONS
PEACHES
PEARS
POPCORN
POTATOES
RASPBERRIES
RHUBARB
SALMON
SEED
SHEEP
SHELLFISH
SNAP BEANS
STRAWBERRIES
SUGAR BEETS
SWEET CORN
TIMBER
TROUT
TURF GRASS
VEGETABLES
WHEAT
APPLES
APRICOTS
ASPARAGUS
BARLEY
BEES
BLUEBERRIES
BULBS
CARROTS
CANOLA
CATTLE
CHERRIES
CHICKENS
CHRISTMAS TREES
CRANBERRIES
DRY BEANS
DRY PEAS
EGGS
GOATS

Potential Climate Change Impacts [6,7,8,9 10 11]

With the advent of climate change coming into worldwide focus; it is necessary to take into account the potential effects this emerging climate crisis may have on the dangers associated with animal, crop, and plant diseases and infestation outbreaks. According to a 2005 Governor's report prepared by the Climate Impacts Group titled *Uncertain Future: Climate Change and its Effects on Puget Sound*, from "paleoclimatological evidence, we know that over the history of the earth high levels of greenhouse gas concentrations have correlated with, and to a large extent caused, significant warming to occur, with impacts generated on a global scale." While the report also indicates that the "ultimate impact of climate change on any individual species or ecosystem cannot be predicted with precision," there is no doubt that Washington's climate has demonstrated change.

In July 2007, the Climate Impacts Group launched an unprecedented assessment of climate change impacts on Washington State. *The Washington Climate Change Impacts Assessment* (WACCIA) involved developing updated climate change scenarios for Washington State and using these scenarios to assess the impacts of climate change on the following sectors: agriculture, coasts, energy, forests, human health, hydrology and water resources, salmon, and urban stormwater infrastructure. The assessment was funded by the Washington State Legislature through House Bill 1303.

In 2009, the Washington State Legislature approved the *State Agency Climate Leadership Act* Senate Bill 5560. The Act committed state agencies to lead by example in reducing their greenhouse gas (GHG) emissions to: 15 percent below 2005 levels by 2020; 36 percent below 2005 by 2035; and 57.5 percent below 2005 levels (or 70 percent below the expected state government emissions that year, whichever amount is greater.). The Act, codified in RCW 70.235.050-070, directed agencies to annually measure their greenhouse gas emissions, estimate future emissions, track actions taken to reduce emissions, and develop a strategy to meet the reduction targets. Starting in 2012 and every two years thereafter, each state agency is required to report to Washington State Department of Ecology the actions taken to meet the emission reduction targets under the strategy for the preceding biennium.

Recognizing Washington's vulnerability to climate impacts, the Legislature and Governor Chris Gregoire directed state agencies to develop an integrated climate change response strategy to help state, tribal, and local governments, public and private organizations, businesses, and individuals prepare. The state Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Health, Natural Resources and Transportation worked with a broad range of interested parties to develop recommendations that form the basis for a report by the Department of Ecology: *Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy*.

Over the next 50 - 100 years, the potential exists for significant climate change impacts on Washington's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts could potentially include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Therefore, climate change has the potential to impact the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses. Recognizing the global, regional, and local implications of climate change, Washington State has shown great leadership in addressing mitigation through the reduction of greenhouse gases.

The forces that shape the climate are also critical to farm productivity. Human activity has already changed atmospheric characteristics such as temperature, rainfall, levels of carbon dioxide (CO_2) and ground level ozone. Warmer climate may give positive effects on food production like the possibility of longer growing seasons; however, the increased potential for weather extremes will pose challenges for farmers. Increased frequency of heat stress, drought,and flood negatively affect crop yields and livestock. Moreover, water supply and soil moisture could make it less feasible to continue crop production in certain areas. The potential loss of snowpack in the Cascades will diminish water needed for summer irrigation for crops in the Columbia Basin and impact salmon recovery across the Northwest. Finally, climate variability and change will modify the risks of fires, weeds, pests, and pathogen outbreaks.

Yakima Valley

2004 research at the Pacific Northwest National Laboratory (PNNL) determined that the $1.3 billion output in the Yakima River Basin was due to water availability. Past droughts caused 10-15% losses of economic output, not including the accumulation of water loss over the years. Compared to a "good year" where the outputs are estimated at $901 million, droughts, and crop losses will become more prevalent due to water shortages increasing from $13 to $79 million per year by mid-century. Water shortages will cause higher costs for farmers and amplify economic losses during drought years. Expected global increases in temperatures will have economic effects not easy to quantify. Decreased snowpack and earlier runoff will decrease streamflow. Higher temperatures will increase evaporation in the soil and decrease its capacity to hold moisture for plants during the hottest parts of the growing season. Insects will find a haven in warmer temperatures, and become a greater problem. Increased numbers of hot days (over 100 °F) are expected to cause increased levels of heat related illness, which makes the agricultural workers population especially vulnerable.

Studies that focus on the water availability to the 370,000 acres (1,500 km^2) of orchards, vineyards, and food crops within the Yakima River Valley are dependent on irrigation which draws water from only five reservoirs. These in turn are dependent on snowpack from the Cascade Mountains. With the arrival of early snowfall, warmer temperatures, and a premature runoff, irrigation water supply is predicted to drop 20-40% by mid-century. The loss to agriculture in the Yakima River Valley would be $92 million for a 2 °C increase and $163 million for a 4 °C increase.

Dairy production

A significant rise in global temperatures will negatively affect dairy production in Washington State which had a total of 560 dairy farms at the end of 2004. Each region will be affected differently based on the different climate and temperature fluctuations. Current predictions forecast that by 2075, milk production in the Yakima River Valley will drastically decrease during the summer months. The worst effects of climate change will be a decrease in daily milk production from 27 kg to 20 kg in the month of August. Whatcom County dairy farms are predicted to be less affected by climate change than Yakima River Valley. Summer milk production in Whatcom County is projected to fall from a little under 27 kg per cow per day to slightly more than 25 kg per cow per day. In both regions the lower milk production is directly correlated to the decrease in consumption of food stuffs. The decrease in food availability during summer is due to increasing annual temperatures that shift precipitation levels and cause a faster

run-off of snowpack. With less food for the cows, milk production drastically decreases during the summer months. Higher temperatures cause a decrease in milk production.

Wine

Washington State currently holds second place, following California, for U.S. wine production. A change in climate will cause vineyards to move. In 2004, wine grapes accounted for $127.5 million and were the state's 4th largest fruit group in terms of value. In 2005, the wine industry as a whole was a $3 billion industry, providing the equivalent of 14,000 full-time jobs.

The Yakima and Mid-Columbia valleys are the most heavily populated vineyard regions. The predicted water shortage within the next decades could lead to a potential crop loss from $13 million to $79 million by mid-century. Because wine varieties are highly sensitive to temperatures, an increase could cause several Eastern Washington areas to move out of the ideal range for certain varietals. The climate shift could make western areas such as Puget Sound more ideal for wine production. If the magnitude of the warming is 2 °C or larger, then a region may potentially shift into another climate maturity type, which is the specific climate favorable to maturing a certain type of grape. For instance, the chardonnay grapes of Western Washington mature well at 14-16 °C, while merlots typically produced in Eastern Washington do best at 16-19 °C. The shift of vineyard concentration to the coastal regions would mean a shift in local land value and use, production, revenue and employment.

Wheat

Eastern Washington produces a large amount of wheat that is affected by climate. In a recent study, winter wheat productions were taken at different elevations, both with and without irrigation, and the best yields were in areas with a lot of rainfall, temperate conditions, and at elevations from 1000 to 1500 meters. Both non-irrigated and irrigated harvests have increased with global warming, which has also allowed for increased production at higher elevations. The harvests also improved with the presence of higher levels of carbon dioxide.

Cranberries

Washington is the fifth largest supplier of cranberries in the U.S., producing 3% of total U.S. production. There are three growing regions in Washington: Whatcom County, Grays Harbor County, and Pacific County. These berries could be affected by higher winter temperatures and rising sea levels due to climate change.

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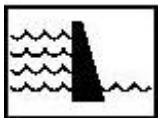
Dam Safety

 Dam Safety	Frequency	50+ yrs	10-50 yrs	1-10 yrs	Annually
	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
	Hazard scale		< Low to High >		

Risk Level

Frequency – There is a dam failure in Washington once every two years.

People – Depending on the location of the dam or levee, failure of either of these types of structures could affect zero to thousands of people depending on the population located downstream.

Economy – The economy of Washington could be affected by a levee or dam failure due to loss of homes and businesses, thus lowering the overall tax base for the affected area.

Environment – Although the environment can be severely affected by a dam failure or levee break due to the flood that results in this type of incident, the likelihood that such an incident will eradicate 10% of a single species or habitat is considered unlikely and thus does not meet this category's minimum threshold.

Property – Property can be dramatically affected in the event of a dam failure or levee break. Should such a failure occur above a highly populated area, damages can be expected to be at least $100 to $500 million dollars.

HIVA Risk Classification for Dam Safety is 2D or Mitigation to Reduce Risk is Optional.

Summary

The hazard – Dam Failure is a term indicating the potential hazard to the downstream area resulting from failure or mis-operation of the dam or facilities. The potential impact of a dam, dike or levee failure in Washington State could result in a flood event. The amount of water impounded is measured in acre-feet, in which an acre-foot of water is the volume that covers an acre of land to a depth of one foot. Dam failures are not routine; two factors influence the potential severity of full or partial dam failure: (1) The amount of water impounded, and (2) the density, type, and value of development downstream.

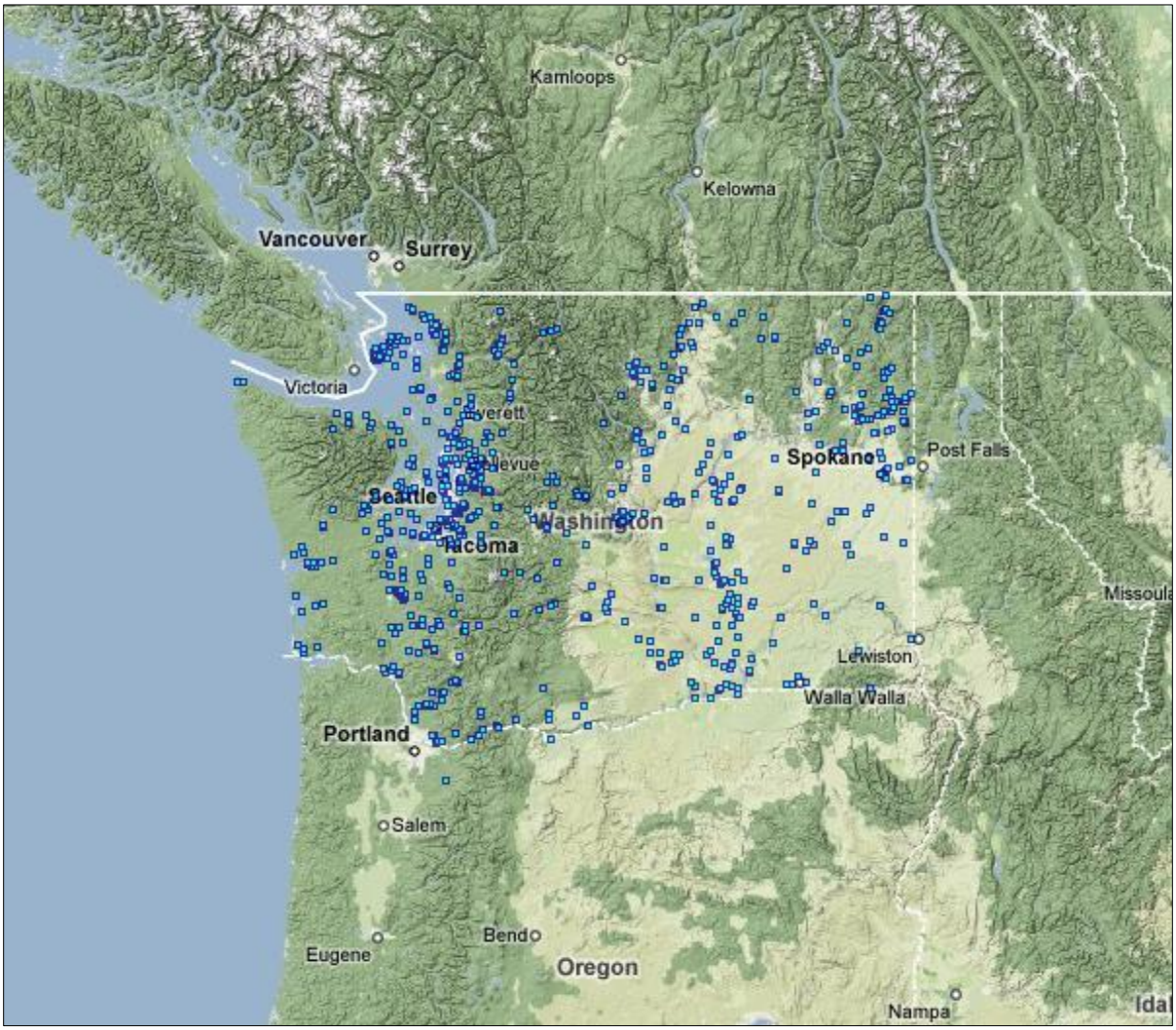
Previous Occurrence – Since 1918, the Washington State Department of Ecology reports fifteen dam-incident events, resulting in nine lost lives. A complete list of dam incidents and failures is attached as Appendix 1 at the end of this profile.

Probability of Future Events – Dam failure or levee breeches can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breeches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow. The overall probability of a dam failure is generally quite low for most dams, typically less than a 500-year flood.

Jurisdictions at Greatest Risk – This summary will not address any one specific dam within a particular jurisdiction or region in an attempt to determine risk, and will only supply information.

Special Note – The intent behind this hazard profile is not to provide an all-encompassing source of information, but to increase awareness of the potential impact from this hazard. Therefore, this profile will not attempt to estimate potential losses. This profile will only provide information on the dams within the State. The Washington State Department of Ecology remains the primary source of information and subject matter experts for Dam related issues.

Figure 6 U.S. Army Corps of Engineers, National Inventory of Dams, Washington State Map



The Hazard

A dam is defined as an artificial barrier that can or does impound more than 10 acre-feet of water. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, which can affect life and property. Heavy periods of rain, flooding, earthquakes, blockages, landslides, lack of maintenance, improper operation, poor construction, vandalism, or terrorism can all result in dam failures. A levee is an embankment raised to prevent a river from overflowing. Levees are also small ridges or raised areas bordering an irrigated field. A dike is an embankment built along the shore of a sea or lake or beside a river to hold back the water and prevent flooding.

Under Washington state law, the Department of Ecology (Ecology) is responsible for regulating dams that capture and store at least 10 acre-feet (about 3.2 million gallons) of water or watery materials such as mine tailings, sewage and manure waste. Since 2007, the US Army Corps of Engineers is responsible to inventory and inspect all private levees and dikes in the state.

The first dam safety law in Washington was passed as part of the state water code in 1917 (RCW 90.03.350). This law required that engineering plans for any dam that could impound 10 or more acre-feet had to be reviewed and approved by the state before construction could begin. Over the years, the Department of Conservation and Development, then the Department of Water Resources, and now the Department of Ecology performed this function. In 1975, the Washington State Department of Ecology assembled the first dam inventory list for our state, which includes all dams owned within our boundaries. The list compiled by the Department of Ecology maintains 1,125 dams

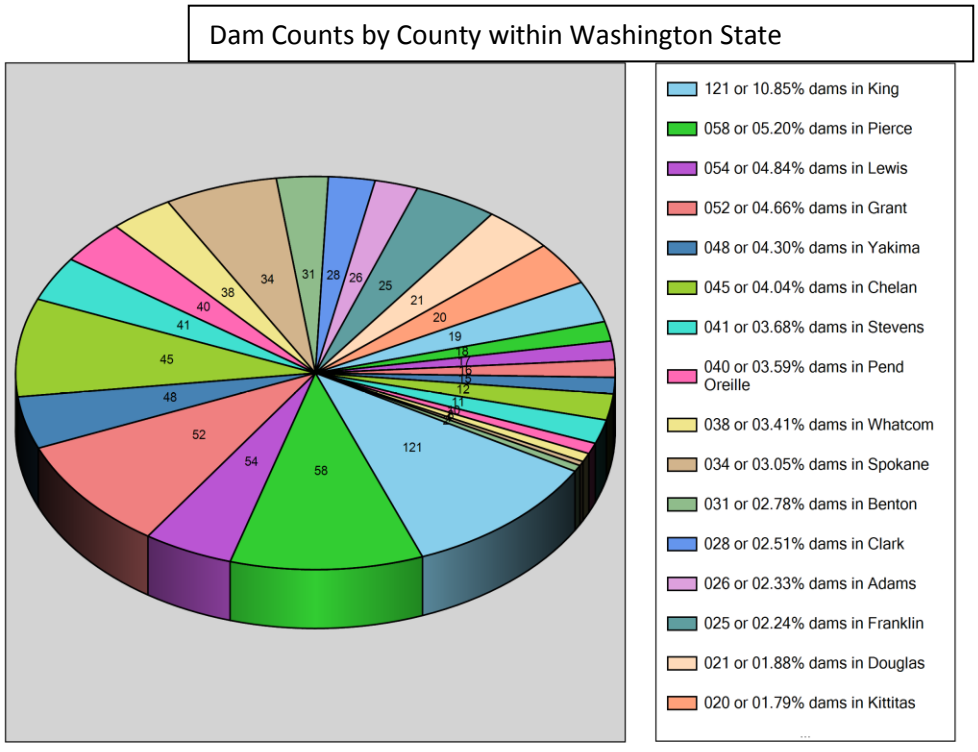


Figure 7. Source: Washington State Department of Ecology. Available at: http://www.ecy.wa.gov/pubs/94016.pdf

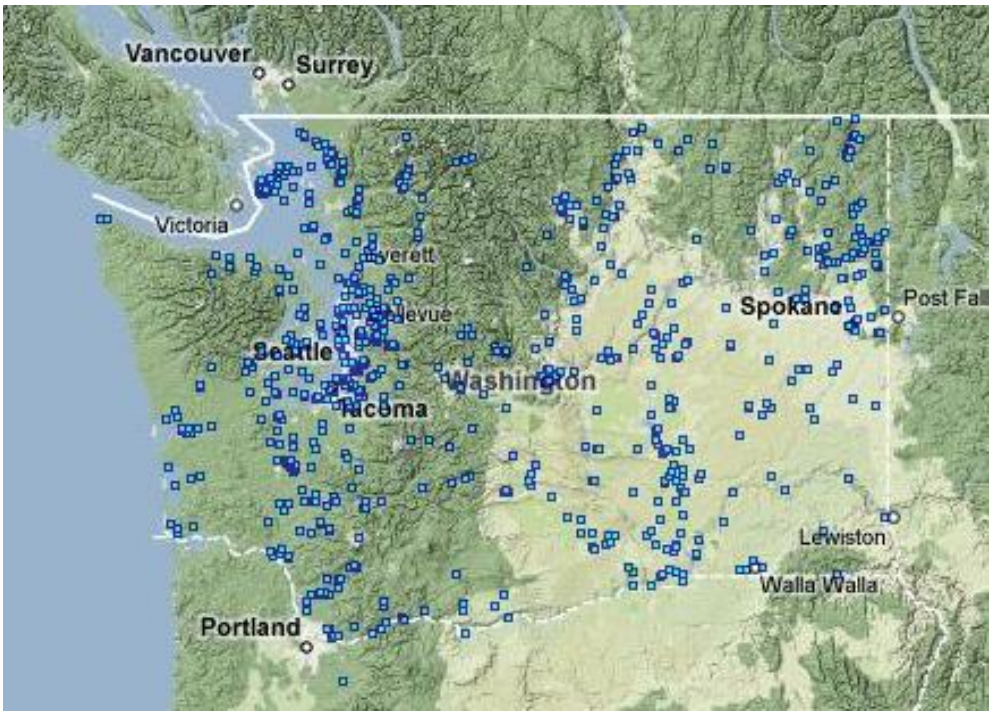
In 1972, the U.S. Congress passed Public Law 92-367 which authorized the development of a National Inventory of Dams (NID). The National Inventory of Dams (NID) contains information on approximately 79,000 dams throughout the U.S. that are more than 25 feet high, hold more than 50 acre-feet of water, or are considered a significant hazard if they fail. The NID is maintained and published by the U.S. Army Corps of Engineers with information from all 50 states, Puerto Rico, and 16 Federal agencies. The current National Inventory of Dams for Washington State lists 798 dams[12].

In order for a dam to be placed on the NID list, the dam must meet at least one of the following criteria:

- High hazard classification - loss of one human life is likely if the dam fails
- Significant hazard classification - possible loss of human life and likely significant property or environmental destruction
- Equal or exceed 25 feet in height and exceed 15 acre-feet in storage
- Equal or exceed 50 acre-feet storage and exceed 6 feet in height

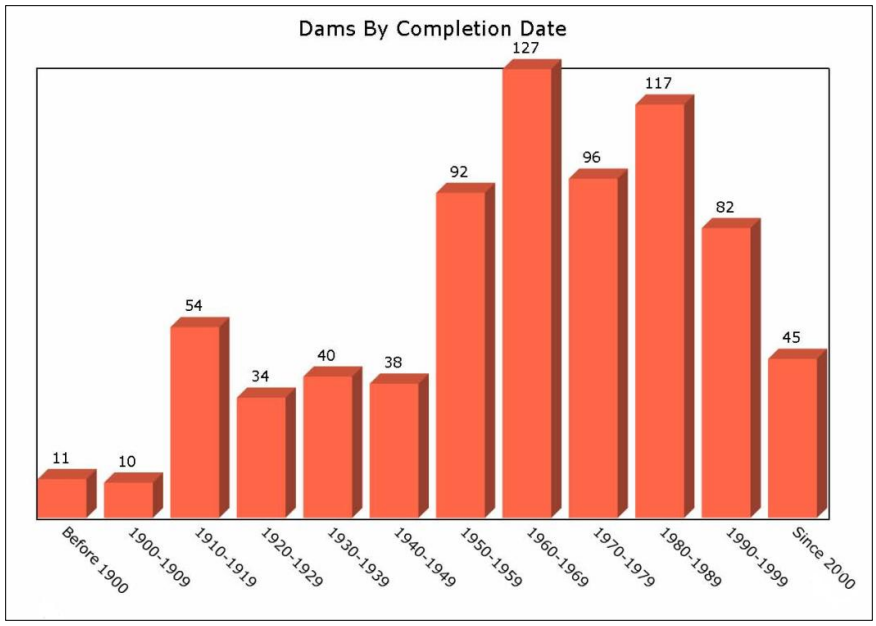
In Washington State, besides regulating dams that meet the NID requirements, there are over 370 dams which do not meet one of the four criteria above, but do fall under the 10 acre-foot jurisdictional level. Ecology's Dam Safety Office currently oversees 996 of the 1,125 dams across the state. Through plan reviews and construction inspections, the agency helps ensure these facilities are properly designed and constructed. To reasonably secure the safety of human life and property, Ecology also conducts inspections of existing dams to assure proper operation and maintenance.

Figure 8 National Inventory of Dams.



The ages of dams in Washington vary from 11 dams constructed pre-1900, to more than 50 dams being completed since 2000. The age of a dam is also a factor in the stability, as many dams are constructed for a specified number of years, as well as the integrity of the materials used to construct the dam may deteriorate over time.

Figure 9 Dams by Completion Date.



Dam Distribution by Classification and Purpose Codes:[13,14]

All dams are assigned a high, significant, or low hazard classification based on potential of loss of life and damage to property should the dam fail. This classification is considered the *Dam Hazard*, and indicates the potential hazard to the downstream area resulting from failure or mis-operation of the dam or facilities. Classifications are updated based on development and changing demographics upstream and downstream. Washington State describes each of the different hazard classifications as follows:

Low - A dam where failure or mis-operation results in no probable loss of human life and low economic and/or environmental loss. Losses are principally limited to the owner's property.

Significant - A dam where failure or mis-operation results in the potential of one to six losses of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. These dams are often located in predominantly rural or agricultural areas but could be located in areas with more dense populations and significant infrastructure.

High - A dam where failure or mis-operation will probably cause a potential loss of greater than seven human lives.

Table 5 Downstream Hazard Classification				
Downstream Hazard Potential	Downstream Hazard Class	Population at Risk	Economic Loss Generic Descriptions	Environmental Damages
Low	3	0	Minimal. No inhabited structures. Limited agriculture development.	No deleterious materials in water
Significant	2	1 to 6	Appreciable. 1 or 2 inhabited structures. Notable agriculture or work sites. Secondary highway and/or rail lines.	Limited water quality degradation from reservoir contents and only short-term consequences.
High	1C	7 to 30	Major. 3 to 10 inhabited structures. Low density suburban area with some industry and work sites. Primary highways and rail lines.	Severe water quality degradation potential from reservoir contents and long-term effects on aquatic and human life.
High	1B	31-300	Extreme. 11 to 100 inhabited structures. Medium density suburban or urban area with associated industry, property, and transportation features.	Severe water quality degradation potential from reservoir contents and long-term effects on aquatic and human life.
High	1A	More than 300	Extreme. More than 100 inhabited structures. Highly developed, densely populated suburban or urban area with associated industry, property, transportation and community lifeline features.	Severe water quality degradation potential from reservoir contents and long-term effects on aquatic and human life.

The following maps demonstrate the general location of the dams within Washington's borders by dam hazards categorization.

Figure 9 High Hazard Dams in Washington State.

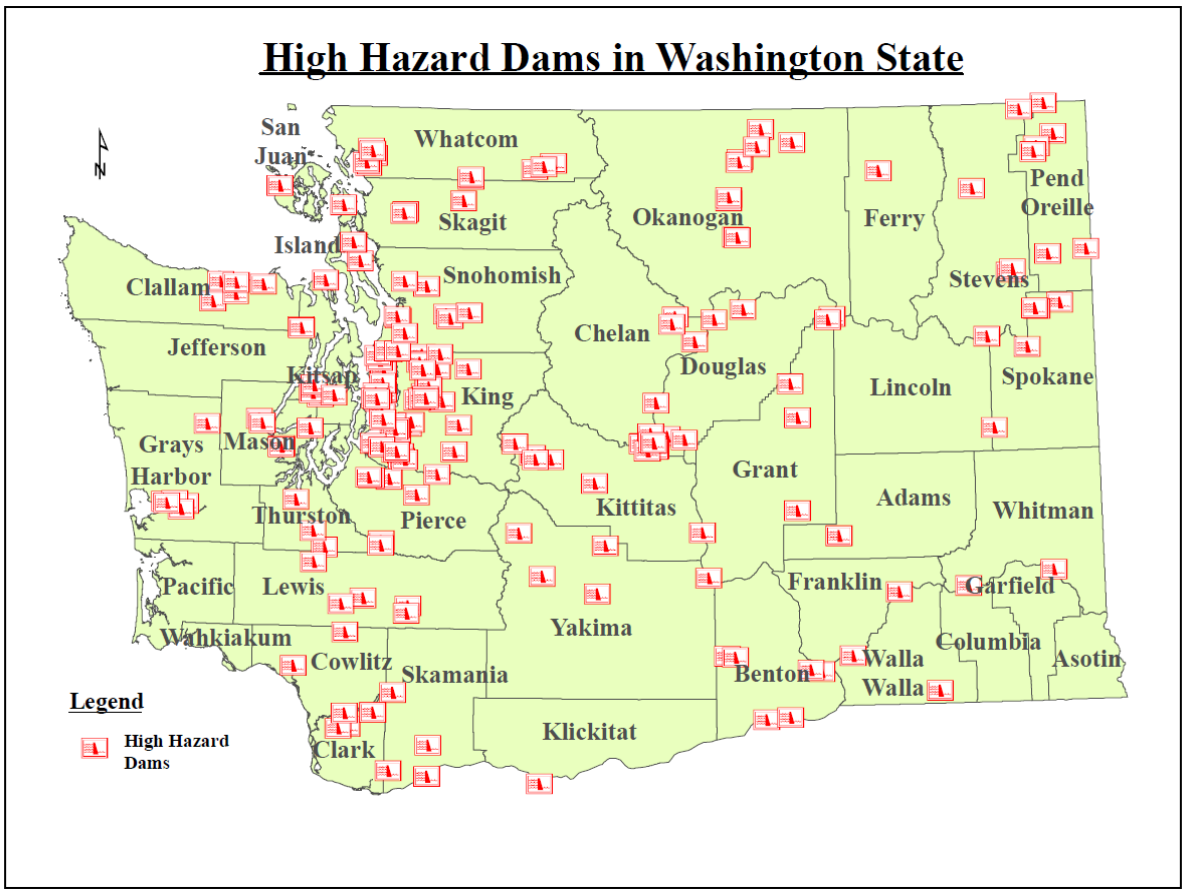


Figure 10 Significant Hazard Dams in Washington State.

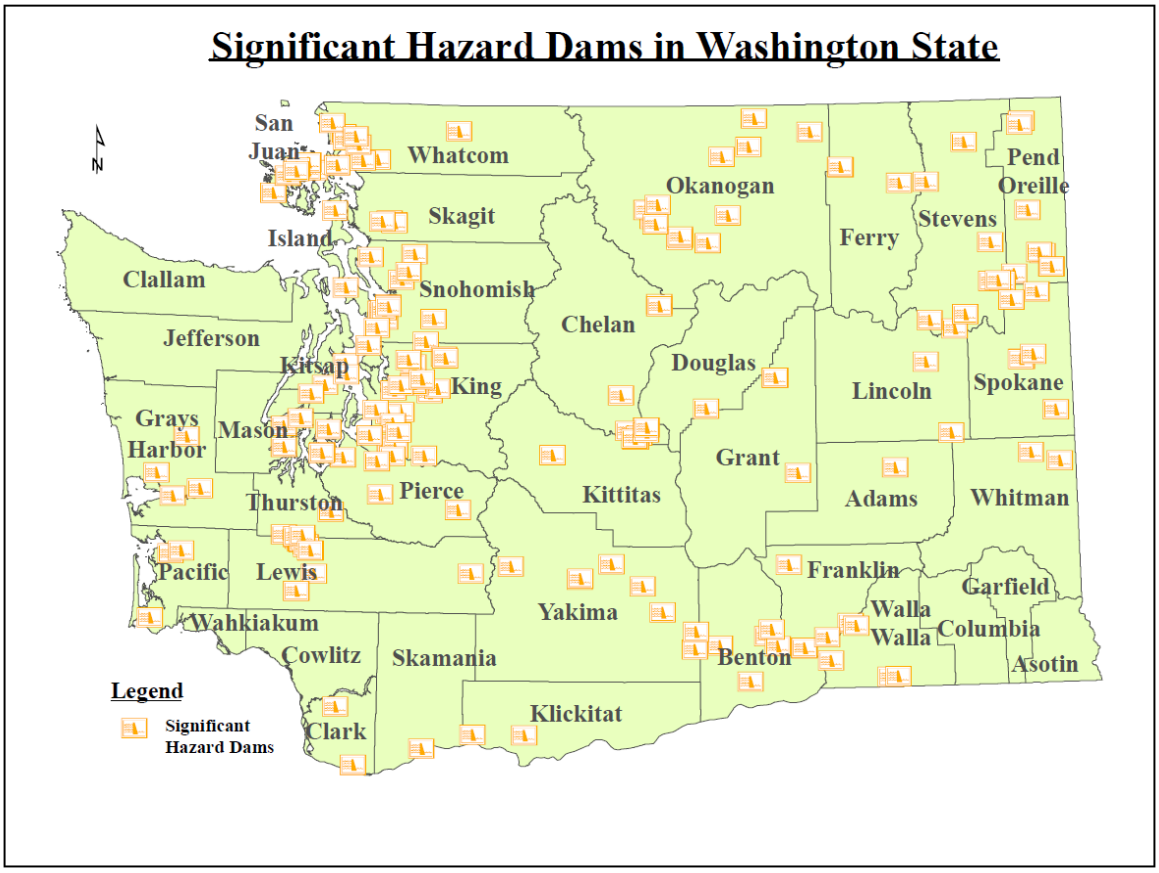
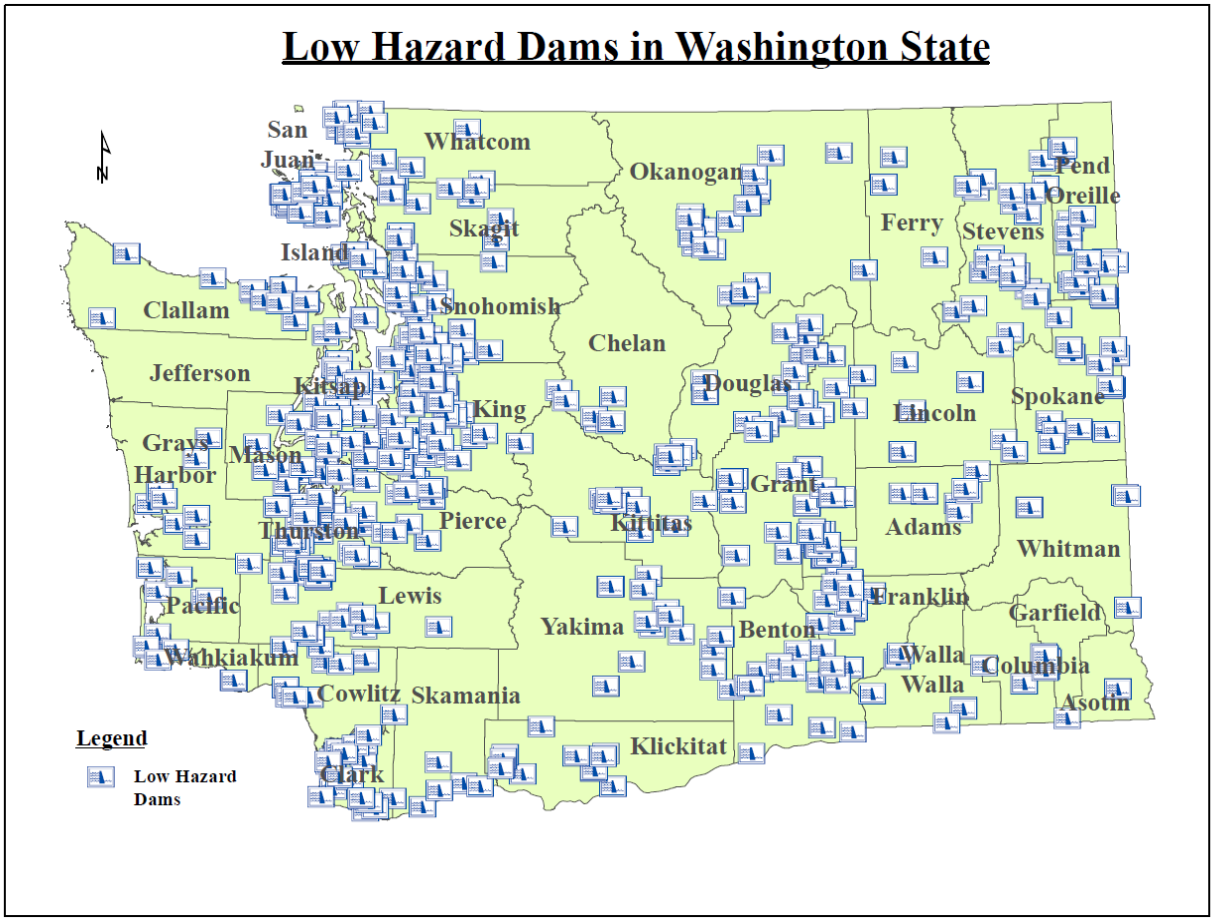


Figure 11 Low Hazard Dams in Washington State.



In addition to the Dam Classification, purpose codes are assigned to each dam as illustrated in the tables below.

Figure 12 Dam Hazard Classifications in Washington State.

Table 1. Dam Hazard Classification

DOWNSTREAM HAZARD POTENTIAL	DOWNSTREAM HAZARD CLASS	POPULATION AT RISK	ECONOMIC LOSS GENERIC DESCRIPTION	ENVIRONMENTAL DAMAGE
LOW	3	0	Minimal. No inhabited structures. Limited agricultural development.	No deleterious material in reservoir contents.
SIGNIFICANT	2	1 - 6	Appreciable. 1 or 2 inhabited structures. Notable agriculture or work sites. Secondary highway and/or rail lines.	Limited water quality degradation from reservoir contents and only short term consequences.
HIGH	1C	7 - 30	Major. 3 to 10 inhabited structures. Low density suburban area with some industry and work sites. Primary highways and rail lines.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.
HIGH	1B	31 - 300	Extreme. 11 to 100 inhabited structures. Medium density suburban or urban area with associated industry, property, and transportation features.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.
HIGH	1A	More than 300	Extreme. More than 100 inhabited structures. Highly developed, densely populated suburban or urban area with associated industry, property, transportation, and community life line features.	Severe water quality degradation potential from reservoir contents and long term effects on aquatic and human life.

TABLE 2. Dam Height Classification

DAM CLASS SIZE	DAM HEIGHT	DAM COUNT	DAM PERCENT
SMALL	6 - 14 Feet	508	45.56 %
INTERMEDIATE	15 - 49 Feet	494	44.30 %
LARGE	50 Feet or more	113	10.13 %

Table 3. Dam Purpose Codes

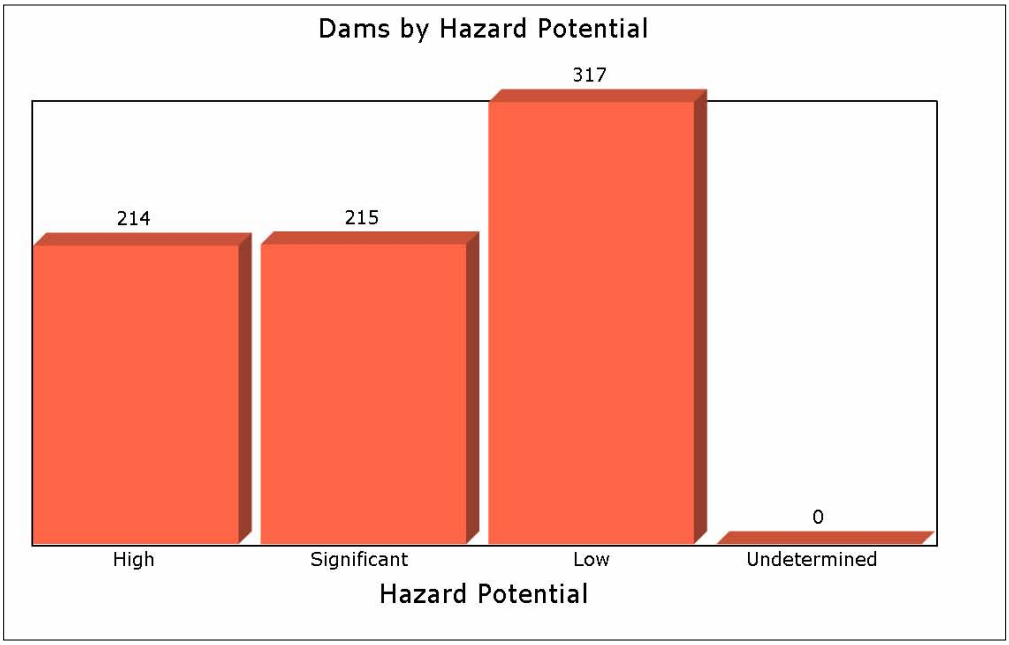
CODE DESCRIPTION	CODE
Flood Control and Storm Water Management	C
Debris Control	D
Fish and Wildlife	F
Grade Stabilization	G
Hydroelectric	H
Irrigation	I
Navigation	N
Other	O
Fire Protection, Stock, or Small Farm Pond	P
Water Quality	Q
Recreation	R
Water Supply	S
Tailings	T

Table 4. Dam Type Codes

CODE DESCRIPTION	CODE
Concrete Buttress	CB
Concrete	CN
Rock Fill	ER
Masonry	MA
Concrete Multiple Arch	MV
Other Type	OT
Concrete Gravity	PG
Earth Fill	RE
some access	SA
Stone	ST
Timber	TI
Concrete Single Arch	VA

A breakdown of dam classification for Washington State dams is as follows:

Figure 13 Dams by Hazard Potential in Washington State.

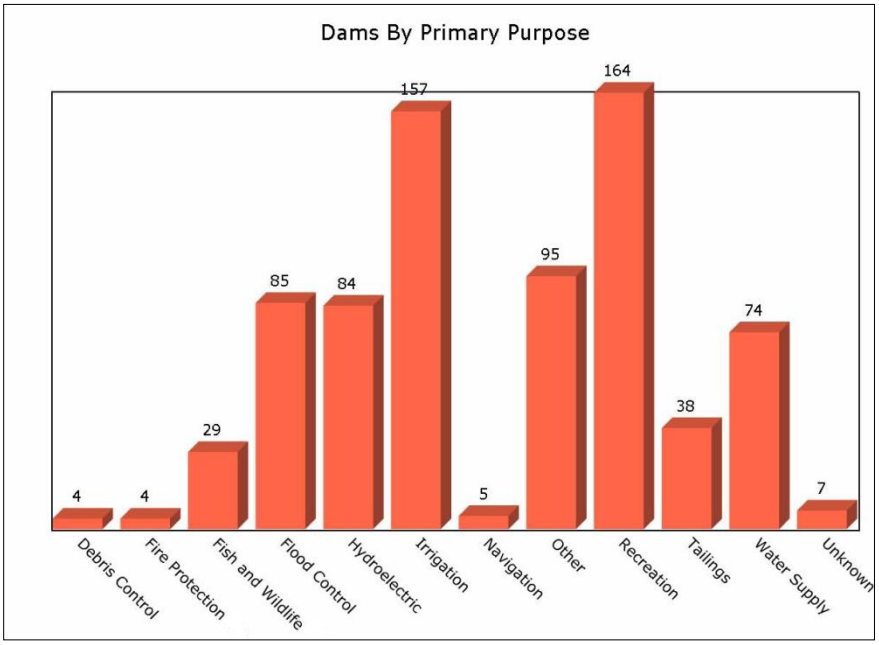


Dams and reservoirs in Washington are constructed for a variety of purposes, including:

- Irrigation
- Domestic water supply
- Recreation
- Water quality
- Hydropower
- Flood control
- Mine tailings storage.

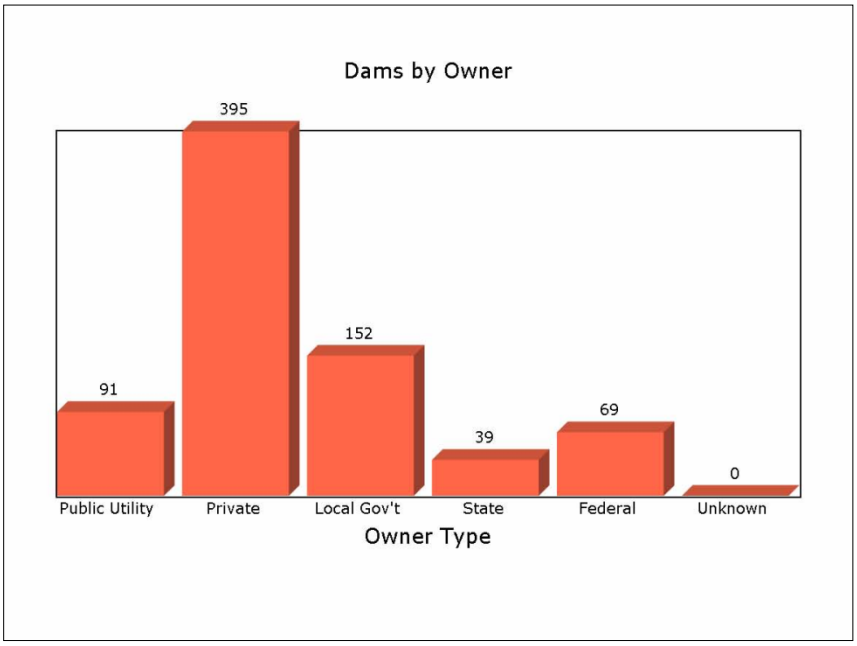
In addition to the above, the larger reservoirs are commonly multi-purpose and serve a number of functions. In addition to man-made dams, here are also dams created by nature – such as beaver dams, as well as debris dams which occur after rapidly running water collects debris as it travels, or after flooding events.

Figure 14 Dams by Primary Purpose in Washington State.



As there are a wide variety of dam and reservoir purposes, there is a correspondingly wide category of dam owners. To help delineate the types of owners, they have been separated into five categories: private, local government, public utilities, federal, and state. The breakdown is as follows:

Figure 15 Dams by Owner in Washington State.



Previous Occurrences

A number of outside forces can cause dam failure, including prolonged periods of rain or flooding, landslides into reservoirs, failure of dams upstream, high winds, and earthquakes.

Failure due to natural events such as earthquakes or landslides is significant because there is little to no advance warning. It is important to note that dam failures can result from natural events, human-induced events, or a combination of the two. Improper design and maintenance, inadequate spillway capacity, or internal erosion or piping within a dam may also cause failure. People, property, and infrastructure downstream of dams are subject to devastating damage in the event of failure.

Washington has had 14 notable dam incidents or failures in the last century (see Appendix 1).

- The Eastwick Railroad fill incident near North Bend failed when a washout plugged a culvert in the embankment in February 1932. This resulted in the destruction of the railroad line, destroyed the village of Eastwick, and contributed to the deaths of seven residents.
- The White River incident happened in July 1976 near Auburn when a surge in flow caused by the increased discharge from Mud Mountain Dam and removal of flashboards at Diversion Dam contributed to the deaths of two children playing in the White River. That incident prompted the adoption of a "rule curve" laying out the scheme to warn those on the river of an impending discharge and a maximum rate of increase in ramping up to the target discharge.[15]
- The Seminary Hill Reservoir located near the city of Centralia failed in October of 1991. Although this failure did not result in any loss of life, 3 million gallons of water drained from the reservoir in less than 2 minutes, resulted in the complete destruction of two homes, and damaged many others. Total damage estimates of this dam failure were around $3 million.
- The Iowa Beef Processors company operated waste pond dam located in Wallula near Richland failed on January 1993. This failure resulted in the release of 300 acre-feet of waste water and washed away a Union Pacific railroad track resulting in the derailment of five locomotives. This dam failure resulted in the highest dollar amount for damages so far, at $5 million.[16]
- The Mill Creek Dam in the city of Cosmopolis failed during a heavy rainstorm on November 12, 2008. The dam was a 10-foot high concrete dam that impounded a 4-acre lake. Although the dam was classified as high hazard, and flooding did occur in a residential area below the dam, no injuries occurred.
- French Slough Dairy Lagoon Failure near the city of Snohomish failed on April 12, 2010. The dairy waste lagoon spilled an estimated 27 million gallons of diluted manure onto adjacent farmland. An undetermined quantity of the liquid drained into nearby French Slough, a tributary of the Snohomish River.

Other dam failures include the May 31, 1889 South Fork Dam failure above Johnston, Pennsylvania, the worst dam disaster in United States history. It released nearly 5 billion gallons of water, contributed to the deaths of 2,209 people, and caused $17 million dollars in damages. The Teton Dam failure in Idaho on June 5, 1976 sent 20 billion gallons of water spilling down Teton Canyon towards Willford, Teton,

Sugar City, Rexburg, Roberts, and Idaho Falls, causing over $2 billion in damages, destroying several thousand homes, and contributing to the deaths of eleven people.

Howard Hanson Dam[17], [18]

Recently, Washington State experienced one potentially serious dam safety issue on the Howard Hanson Dam. The Howard Hanson Dam is an earthen dam located near the headwaters of the Green River in King County. The dam was constructed by the U.S. Army Corps of Engineers and went into operation in 1961 for the purpose of flood control for the Green River Valley. The dam and the levees along the Green River have provided effective flood control over the years. However, during the storms in January 2009, structural weaknesses were discovered. Two depressions on the right abutment to the flood control dam were weakened by heavy rains. Officials warned that the dam would not be able to hold a full reservoir and there was a risk of flooding through the Green River Valley.

Initially the Army Corps of Engineers notified the City of Auburn of the situation and advised of the potential to release more water than usual during extreme rain events. As a result, it was determined that parts of Auburn were at a higher risk of flooding. It was felt the situation would continue for approximately 18-24 months, or potentially longer depending on the nature of the repair work which needed to be completed at the dam.

Since discovering the problem, the Army Corps of Engineers completed interim repairs at the Howard Hanson Dam which reduced the risk of flooding along the Green River Valley from 1 in 3 to 1 in 25. Great emphasis was put on public education with respect to evacuation, sheltering, and flood insurance. Millions of dollars were spent adding sandbags on levees through Kent, Renton, Auburn, and Tukwila. In addition to the repair work completed by the Corps, these temporary repairs have also helped reduced the risk of flooding. As of October 2011, repair work has restored the dam back to its original levels of risk reduction.

Pride Packing Dam Spillway Failure[19]

Pride Packing Ranch 19 Dam is located near Sunnyside Washington, and was one of the dams discovered under the unpermitted dams initiative executed by the Department of Ecology. The 30-foot high dam was found to have an inadequate spillway, so Ecology required the dam owner to construct a new spillway to handle floods from the watershed. Completed in April 2010, the spillway consisted of a concrete chute across the crest of the dam followed by a gabion-lined spillway chute down the face of the dam.

On April 25, water released from an upstream reservoir resulted in a few inches of flow over the new spillway. This small flow resulted in a major failure of the gabion-lined chute, as some of the flow got beneath the filter fabric underlying the gabions and scoured the highly erodible foundation soils. Fortunately, the erosion stopped at the end of the concrete chute section across the crest, so the dam was not in real danger of failing. Nonetheless, the damage to the spillway was severe, and the owner had to rebuild the downstream chute, this time with reinforced concrete. The concrete spillway was completed in October2010, and the reservoir was placed back in service.

Notable Dam Failures and Incidents In Washington State

Project Name	Location	Date of Failure	No. of Lives Lost	Nature of Failure and Damage
Masonry Dam (Boxley Burst)	Near North Bend	December 1918	0	Excessive seepage through glacial moraine abutment caused mud flow about 1 mi. from reservoir. Destroyed RR line and village of Eastwick.
Eastwick RR Fill Failure	Near North Bend	February 1932	7	Blockage of culvert by slide caused RR Fill to back up water and fail. Destroyed RR line and village of Eastwick.
Loup Loup Dam	Near Malott	April 1938	0	50 foot high hydraulic fill dam failed when emergency spillway was undercut during a flood. Destroyed 25 homes and left 75 people homeless. Destroyed 1/2 mile of state highway.
Lake Dawn Dam	Port Angeles	February, 1950	0	Heavy Rains caused overtopping and failure of earthen dam. 1 home destroyed, $4000 damage
North Star Sand & Gravel Dams	Everett	December 1967	0	40 foot high dam washed out by overtopping due to lack of spillway. 25 foot high dam rebuilt, also failed, washed out GN railroad tracks, derailed passing train.
Pillar Rock Dam	Wahkiakum County	January 1970	0	Logging roadfill culvert blocked by debris, overtopped and failed, caused 25 foot high concrete gravity dam to fail. 3 homes and fish cannery destroyed.
Sid White Dam	Near Omak	May 1971	0	Earthen dam failed due to seepage through animal burrows. Caused second dam to fail and dumped debris into town of Riverside.
Horseshoe Lake Blowout	Chewelah	May 1974	0	Outlet tunnel through 50 foot high natural ridge collapsed causing ridge to fail. Drained 20 foot deep lake. Extensive flood damage and debris deposits on cropland in downstream valley.

Notable Dam Failures and Incidents In Washington State

Project Name	Location	Date of Failure	No. of Lives Lost	Nature of Failure and Damage
White River Incident	Near Auburn	July 1976	2	Surge in flow caused by increased discharge from Mud Mountain Dam and removal of flashboards at PP&L Diversion Dam. Killed 2 children playing in White River
Alexander Lake Dam	Near Bremerton	December 1982	0	Spillway undermined and failed during heavy rains. Caused damage at fish hatchery and homes in Gorst.
Upriver Dam	Spokane	May 1986	0	Hydropower facility failed by overtopping. Lightning struck system, turbines shut down. Water rose behind dam while trying to restart. Backup power systems failed, could not raise spillway gates in time. Caused $11 million damage to facility.
Chinook Dam	Pacific County	November 1990	0	Heavy rains overtopped the embankment and undermined the spillway, leading to failure of dam. Approximately $100,000 damage to facility.
Seminary Hill Reservoir City of Centralia	Centralia	October 1991	0	Failure along weak rock zone in hillside caused massive slide which breached reservoir. 3 million gallons of water drained from reservoir in 3 minutes. 2 homes destroyed, many homes damaged, $3 million in damage.
Iowa Beef Processors Waste Pond Dam No. 1	Wallula near Richland	January 1993	0	Failure of 15-foot high embankment released 300 acre-feet of waste water. Failure attributed to high reservoir levels due to snowmelt, entering animal burrows near embankment crest, and eroding dam. Washed out Union Pacific RR tracks, derailed 5 locomotives. $5 million in damage.

Figure 16 Source: Washington State Dept. of Ecology. Available at: http://www.ecy.wa.gov/programs/wr/dams/Reports/damfailure_ws.pdf

Probability of Future Events [20, 21]

Failure of a dam can have many effects such as loss of life and damage to structures, roads, utilities, crops, and the environment. Economic losses from a dam failure could include a lowered tax base, because of homes and businesses lost in a dam failure event. Despite best efforts to promote dam safety and assist owners in maintaining their dams in a safe manner, dam failures sometimes occur. Reasons for dam failures include:

Overtopping - 34% of all failures (nationally)

- Inadequate Spillway Design
- Debris Blockage of Spillway
- Settlement of Dam Crest

Foundation Defects - 30% of all failures (nationally)

- Differential Settlement
- Sliding and Slope Instability
- High Uplift Pressures
- Uncontrolled Foundation Seepage

Piping and Seepage - 20% of all failures (nationally)

- Internal Erosion Through Dam Caused by Seepage-"Piping"
- Seepage and Erosion Along Hydraulic Structures Such as Outlet, Conduits or Spillways, or Leakage Through Animal Burrows
- Cracks in Dam

Conduits and Valves - 10% of all failures (nationally)

- Piping of Embankment Material Into Conduit Through Joints or Cracks

Other - 6% of all failures (nationally)

Periodic inspections of existing dams are conducted in areas where dam failure and release of the reservoir contents could pose the potential for loss of life. The inspections are done to ensure that deficiencies are found and corrected, to determine that the dam is being operated safely, and to confirm that maintenance of the dam is being performed. When deficiencies are found at an inspected dam, the dam owner is responsible for correcting those deficiencies. If the owner fails to correct deficiencies at the dam, the dam can be declared a public nuisance and removed through an abatement proceeding in Washington Superior Court.

The failure to implement a suitable operation and maintenance program at dams is a common thread in dam incidents occurring in Washington. Many municipalities operate old reservoir systems and find it difficult to fund effective operation and maintenance programs. While the failure of projects with a high hazard potential for loss of life are increasingly remote, the number of failures of low hazard projects that provide important infrastructure roles are on the rise. With the state population increasing every year, homes are frequently being constructed downstream from dams. Dams rated at the low hazard

rating are not built to the more stringent requirements of high hazard dams, and these represent the greatest potential threat to public safety. The Department of Ecology's Dam Safety Office (DSO) examines low hazard dams only when contacted by the owner to address a problem or if they have received a complaint. They have conducted a review of aerial photos and followed up with field work for dams that are not in their inventory but are of jurisdictional size and the downstream hazard setting is significant or high.

Periodic inspections are conducted on existing dams that are located in areas where dam failure and release of reservoir contents could pose the potential for loss of life. The inspections are intended to identify deficiencies, and to reasonably assure that safe operation and confirm that maintenance is being adequately performed. Inspections are performed by the Department of Ecology every 5 years for dams with high and significant downstream hazard classifications. The inspections are performed by professional engineers from the Dam Safety Office and involve: review and analysis of available data on design, construction, operation, and maintenance of the dam and its appurtenances; visual inspection of the dam and its appurtenances; evaluation of the safety of the dam and its appurtenances, which may include assessment of the hydrologic and hydraulic capabilities, structural stabilities, seismic stabilities, and other conditions which could constitute a hazard to the integrity of the structure; evaluation of the downstream hazard classification; evaluation of the operation, maintenance, and inspection procedures employed by the owner and/or operator; and review of the emergency action plan for the dam including review and/or update of dam breach inundation maps. The Department of Ecology prepares a comprehensive report of the findings of the dam inspections, which includes findings from the inspections, and any required remedial work to be performed.[22]

Based on the 2010 report, there are now 388 dams in Washington sited above populated areas for which Ecology's Dam Safety Office is the sole regulatory agency, an increase of 55 dams since 2006. This sharp increase was primarily due to the discovery of dozens of dams under the unpermitted dams initiative. Despite this increase in workload, all of the 188 dams located upstream of three or more residences (high downstream hazard potential) have been inspected at least once and are now on a five-year inspection cycle. The first round of inspections for the 210 dams classified as having a significant downstream hazard has also been completed, and these projects are also on a 5-year inspection cycle. The addition of two engineering positions in the 2009 budget allowed the Dam Safety Office to complete the unpermitted dams project and still meet the inspection workload required to achieve these cycles. This resulted in 75 inspections of high hazard dams, 60 inspections of significant hazard dams, and over 200 inspections of unpermitted dams. The unpermitted dams initiative alone added 20 dams with safety deficiencies to the list. Another 10 dams were added to the list from our regular periodic inspection activity. Aging dams are deteriorating and may lack maintenance, or do not meet higher safety standards required by downstream population growth or increasing seismic standards.

Through 2010, safety deficiencies have been identified on a total of 209 dams, and actions to correct deficiencies are summarized below:

- Deficiencies fully corrected on171 dams.
- Partial repairs completed on 11 dams.
- Engineering studies and/or design work is underway for 19 dams.

Some deficient dams have been on the list for several years with minimal progress on correcting safety deficiencies. These dams have significant deficiencies but do not pose an imminent threat of failure, so enforcement actions have not yet been taken. Owners of these dams have cited insufficient funding as the reason for their lack of progress in getting repairs done.

While periodic inspections are the basis for limiting the risk of dam failure, increasing the level of disaster preparedness, including evacuation routes, notification procedures, and personal preparedness training and hazard awareness in communities downstream from high hazard dams may also play a factor in lessening the outcome of a dam failure, should one occur.

Washington also has levees interspersed around the state that function as flood control structures. Failure of a levee, dike, or drainage system can have similar effects as a dam failure. In 2007, Congress passed the National Levee Safety Act, which for the first time directed the US Army Corps of Engineers to inventory all private levees in the nation. The National Levee Database (NLD), developed by the U.S. Army Corps of Engineers (USACE), is the focal point for comprehensive information about our nation's levees. The database contains information to facilitate and link activities, such as flood risk communication, levee system evaluation for the National Flood Insurance Program (NFIP), levee system inspections, flood plain management, and risk assessments. The NLD continues to be a dynamic database with ongoing efforts to add levee data from federal agencies, states, and tribes.[23]

The Washington Department of Ecology (Ecology) prepared a 2010 report in response to a 2009 budget proviso by the Washington Legislature directing Ecology to "conduct a study to: Determine the number of decertified levees in the state and Identify strategies for maintaining accreditation, re-accrediting, or recertifying levees so they are recognized by federal agencies as providing optimum protection for the communities protected by the levees."[24] A critical task of this assessment has been to compile the first comprehensive statewide levee database for Washington State. For this study, emphasis was placed on the compilation and synthesis of existing data, rather than on the creation new spatial datasets. The database is an inventory of the location and attributes of all currently known levees at the statewide level. In line with the guiding proviso, however, particular attention was paid to levees that are accredited or have been accredited in the past as providing 100-year protection.

Data for a statewide levee inventory were derived from a variety of sources. These include FEMA's National Flood Hazard Layer, FEMA Region X, USACE Portland District, USACE Seattle District, and USACE Walla Walla District, as well as previously archived FEMA levee data stored at the Department of Ecology. In addition to these sources, local levee managing agencies were contacted to provide feedback on the specific levees within their jurisdictions. For the purposes of this project, levees of focus are defined as 1) currently accredited/pending accreditation 2) provisionally accredited or 3) de-accredited/pending de-accreditation. To date, approximately 697 miles of levees are in the inventory. Approximately 125 miles of levees of focus have been identified. Of the 697 total miles of levees in Washington State, 13% were found to be classified as federal, 42% non-federal, and 45% unknown. Of all levee miles in the state, approximately 9% of mileage was found to be accredited. Levees have been identified in 30 of 39 Washington Counties, with levees of focus being found in 10 of the 39 Washington Counties.

Nonetheless, it is hard to assess the hazard and risk to Washington citizens, property, and environment due to levees. When this inventory is available and the condition of all the levees in Washington is known, a hazard and risk assessment may be recommended.

Additionally, Washington State statute allows for flood districts and flood control zone districts by county. Municipal Research and Services Center of Washington (MRSC) lists 15 counties with these types of districts. These districts perform investigation, planning, construction, improvement, replacement, repair or acquisition of dams, dikes, levees, ditches, channels, canals, banks, revetments

and other works, appliances, machinery and equipment and property and rights connected therewith or incidental thereto, convenient and necessary to control floods and lessen their danger and damages.[25] Many municipalities in Washington State have stormwater districts, which are similar to flood districts but on a smaller scale.

Jurisdictions Most Threatened and Vulnerable to Future Events

Dam failure or levee breeches can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breeches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow. The overall probability of a dam failure is generally quite low for most dams, typically less than a 500-year flood. This summary will not address any one specific dam within a particular jurisdiction or region in an attempt to determine risk, and will only supply information. Of the 1029 dams in Washington State regulated by the Department of Ecology, only 12 significant hazard dams and 20 high hazard dams have reported deficiencies. Through 2010, deficiencies were fully corrected on 171 dams, while partial repairs were completed on 11 dams, and engineering studies and/or design work is underway on 19 dams.

Potential Climate Change Impacts [26,27,28,29]

With the advent of climate change coming into worldwide focus; it is necessary to take into account the potential effects this emerging climate crisis may have on the dangers associated with dam and levee failures. The research done so far indicates the potential for unusual or more frequent heavy rainfall and flooding is greater is some areas while the potential for drought is predicted in other areas. Landslide frequency is correlated with heavy rainfall and flooding events.

According to a 2005 Governor's report prepared by the Climate Impacts Group titled *Uncertain Future: Climate Change and its Effects on Puget Sound*, from "paleoclimatological evidence, we know that over the history of the earth high levels of greenhouse gas concentrations have correlated with, and to a large extent caused, significant warming to occur, with impacts generated on a global scale." While the report also indicates that the "ultimate impact of climate change on any individual species or ecosystem cannot be predicted with precision," there is no doubt that Washington's climate has demonstrated change.

In July 2007, the Climate Impacts Group launched an unprecedented assessment of climate change impacts on Washington State. *The Washington Climate Change Impacts Assessment* (WACCIA) involved developing updated climate change scenarios for Washington State and using these scenarios to assess the impacts of climate change on the following sectors: agriculture, coasts, energy, forests, human health, hydrology and water resources, salmon, and urban stormwater infrastructure. The assessment was funded by the Washington State Legislature through House Bill 1303.

In 2009, the Washington State Legislature approved the *State Agency Climate Leadership Act* Senate Bill 5560. The Act committed state agencies to lead by example in reducing their greenhouse gas (GHG) emissions to: 15 percent below 2005 levels by 2020; 36 percent below 2005 by 2035; and 57.5 percent below 2005 levels (or 70 percent below the expected state government emissions that year, whichever

amount is greater.). The Act, codified in RCW 70.235.050-070, directed agencies to annually measure their greenhouse gas emissions, estimate future emissions, track actions taken to reduce emissions, and develop a strategy to meet the reduction targets. Starting in 2012 and every two years thereafter, each state agency is required to report to Washington State Department of Ecology the actions taken to meet the emission reduction targets under the strategy for the preceding biennium.

Recognizing Washington's vulnerability to climate impacts, the Legislature and Governor Chris Gregoire directed state agencies to develop an integrated climate change response strategy to help state, tribal, and local governments, public and private organizations, businesses, and individuals prepare. The state Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Health, Natural Resources and Transportation worked with a broad range of interested parties to develop recommendations that form the basis for a report by the Department of Ecology: *Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy*.

Over the next 50 - 100 years, the potential exists for significant climate change impacts on Washington's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts could potentially include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Therefore, climate change has the potential to impact the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses. Recognizing the global, regional, and local implications of climate change, Washington State has shown great leadership in addressing mitigation through the reduction of greenhouse gases.

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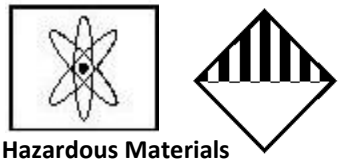
Hazardous Materials



Hazardous Materials

Frequency	50+ yrs	10-50 yrs	1-10 yrs	Annually
People	<1,000	1,000-10,000	10,000-50,000	50,000+
Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
Environment	<10%	10-15%	15%-20%	20%+
Property	<$100M	$100M-$500M	$500M-$1B	$1B+
Hazard scale			< Low to High >	

Risk Level

Frequency – Hazardous Material releases happen in Washington on an annual basis.

People – Though Hazardous Material releases can adversely affect or kill people, the likelihood that a Hazardous Material release would kill more than 1,000 people to meet the minimum threshold for this category is highly unlikely.

Economy –Recovery from a Hazardous Material release is not likely to cost 1% of the States Gross Domestic Product (GDP) to meet this category's minimum threshold.

Environment – While the environment and species that inhabit the areas in and around a Hazardous Material release can be adversely affected in an event, the likelihood that 10% of a single species or habitat will be lost due to a Hazardous Material release is highly unlikely.

Property – Recovery from a Hazardous Material release is not likely to cost over $100M to meet this category's minimum threshold.

HIVA Risk Classification for Hazardous Materials is 2C or Mitigation to Reduce Risk is Required.

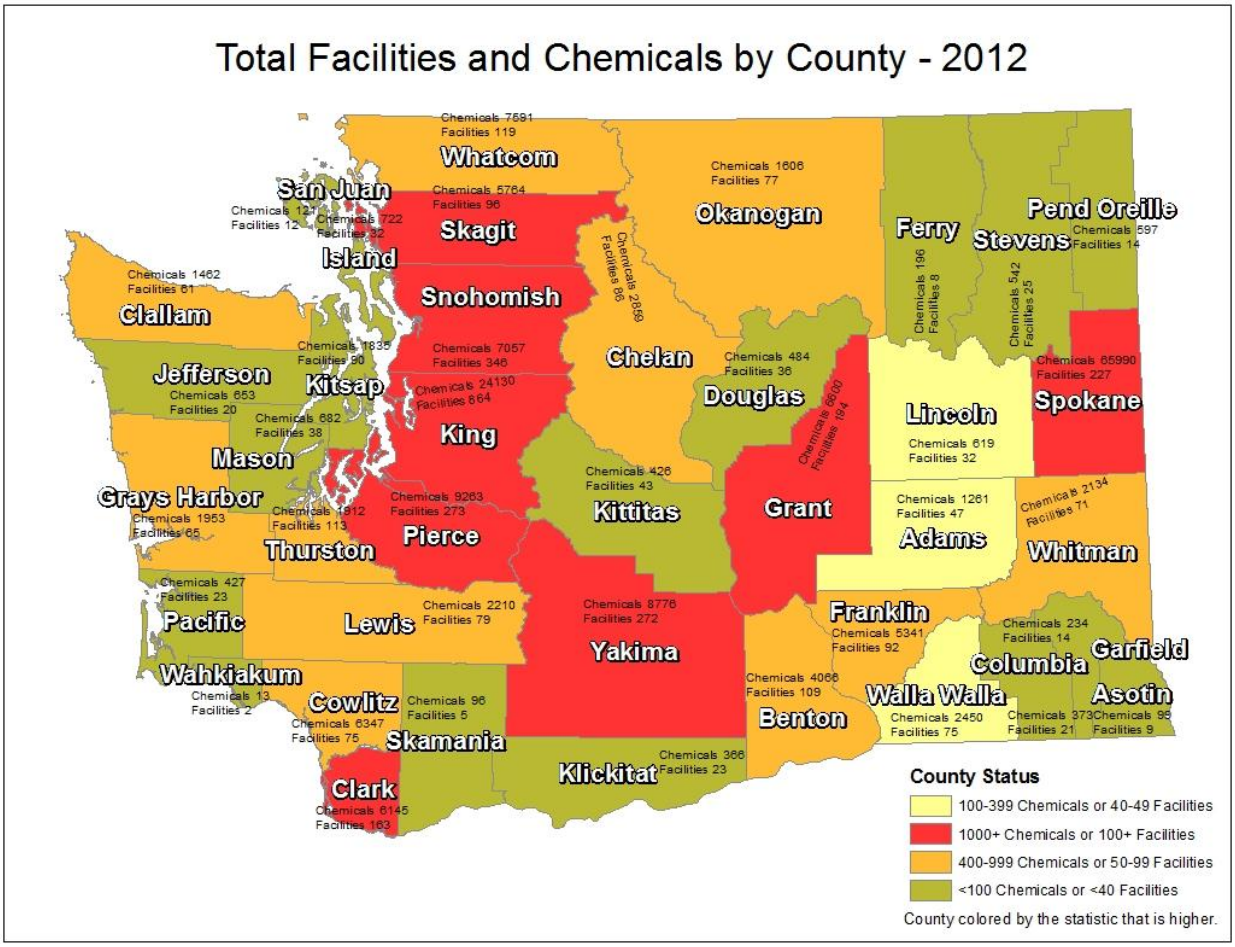


Figure 17 County HazMat Facilities and Chemicals

Summary

The Hazard – Hazardous materials incidents include the unwanted, unplanned, or deliberate release or escape of explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, or radioactive substances that may cause or create a potential risk to public health, safety, or the environment.

Previous Occurrences – Washington has a varied history of hazardous materials incidents and while some appear to be on the downward trend (such as drug lab incidents) others remain fairly constant, but vary by location and amount (oil and chemical spills or releases, etc.).

Probability of Future Events – Determining the probability of future hazardous materials incidents is difficult because so many factors can contribute and there are so many different types of incidents.

Jurisdictions at Greatest Risk – Hazardous materials incidents have impacted every county in the state and are dependent upon a variety of conditions. Western Washington counties are most at risk due to dense industrial and populated areas and major transportation routes surrounding the fragile ecosystems of the Puget Sound and coastal waterways. Some Eastern counties are increasingly at risk with growth in population, industry, and transportation. For the purpose of this profile, analysis will not be conducted to determine the jurisdiction of greatest risk.

Special Note – This profile will not attempt to estimate potential losses to state facilities due to hazardous materials incidents.

The following hazardous materials categories are considered for this profile:

- Spills either at fixed facilities or on transportation routes which include water, land and pipeline
- Methamphetamine Labs
- Radioactive Materials
- Fukushima Tsunami and Nuclear Reactor
- Hanford Nuclear Reservation
- Columbia Generation Station
- Washington Cleanup Sites for Leaking Underground Storage Tanks, Brownfields, and Superfund

The Hazard[30, 31, 32, 33, 34]

Hazardous materials are defined as such because of their chemical, physical, or biological nature which can pose a potential risk to human health, property, or the environment when released. A release may occur by spilling, leaking, emitting toxic vapors, or any other process that enables the material to escape its container, enter the environment, and create a potential hazard. Potential sources of hazardous material releases include, but are not limited to: superfund sites, storage facilities, residences, manufacturers, transportation carriers, hospitals/medical facilities, veterinary hospitals/clinics, and Brownfield sites. The hazard can be explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, or radioactive, and can exhibit qualities of a biological agent. There are also naturally occurring hazardous materials releases. These naturally occurring hazardous material releases may produce the same potential risk to human health as the manufactured chemicals or agents.

In addition to the standard definition of hazardous materials, there are other agents which also fall into this category. Etiologic agents are those microorganisms and microbial toxins that cause disease in humans and include bacteria, bacterial toxins, viruses, fungi, rickettsiae, protozoans, and parasites. These disease-causing microorganisms may also be referred to as infectious agents. Arthropods and other organisms that transmit pathogens to animals (including humans) are called vectors. Etiologic agents, vectors, and materials containing etiologic agents are recognized as hazardous materials. Radioactive agents are materials that emit beta or gamma radiation.

Hazardous materials incidents can occur naturally and during the manufacture, transportation, storage and use of hazardous materials. These incidents can occur as a result of human error, natural hazards, deliberate deed, or a breakdown in equipment or monitoring systems. The impact depends upon the quantity and physical properties of the hazardous material, environmental and weather factors at the point of release, the type of release, and its proximity to human and wildlife populations and valuable ecosystems.

In 1986 Congress enacted the Emergency Planning and Community Right to Know Act (EPCRA) as part of the Superfund Amendments and Reauthorization Act (SARA) as a result of public concern regarding the environmental and safety hazards posed by the storage and handling of toxic chemicals. This act, known as SARA Title III, established requirements for federal, state, tribal, and local governments as well as industry regarding emergency response planning and the public's right to know about hazardous chemicals stored and released in their community. These provisions helped increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment.

In 1987, Washington adopted the Federal SARA Title III regulations in Chapter 118-40 of the Washington Administrative Code and established the Washington State Emergency Response Commission (SERC) to oversee implementation of requirements imposed by SARA Title III, including the creation of planning districts, designation of the Local Emergency Planning Committees (LEPC), and the development of a statewide master plan for hazardous materials incident response. The Washington SERC is comprised of a broad-based membership including representatives from private industry, state, tribal, and local governments. In addition, the Washington State Patrol, the Washington State Military Department - Emergency Management Division, and the Department of Ecology have specific responsibilities under the state regulation. The LEPC's representation consists of local elected officials, law enforcement, emergency management, fire fighting, health professionals, hospital, transportation, environmental,

media, community groups, and industry representatives for each planning district. LEPCs are required to develop a local emergency plan for their district and to collect EPCRA information submitted by industry.

According to the Department of Ecology and Washington Emergency Management Division, in 2012 Washington State has 41 LEPCs, one for each of Washington's 39 counties as well as for the Emergency Services Coordinating Agency, the Southwest Snohomish Emergency Services Coordinating Agency, and the Fort Lewis military installation/reservation.

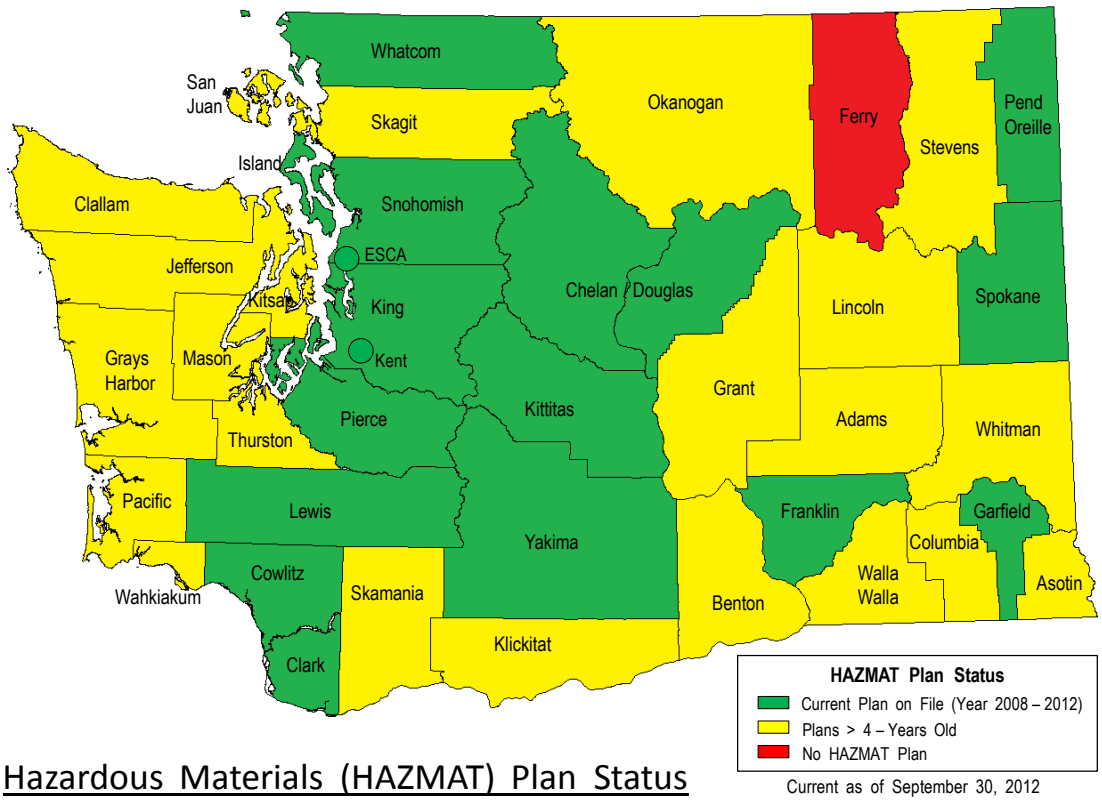


Figure 18 County HazMat Plan

The Washington SERC requires that all facilities or businesses that have reportable quantities of certain chemicals must complete a Tier Two – Emergency and Hazardous Chemical Inventory report annually for each hazardous or extremely substance present in excess of its threshold at any one time. The Washington Department of Ecology receives all EPCRA reports and manages EPCRA data on behalf of the Washington SERC. Most EPCRA reports must also be submitted to the LEPC, the local fire department or, when appropriate, to tribal nations or tribal emergency response commissions, their designated LEPC's, and fire departments.

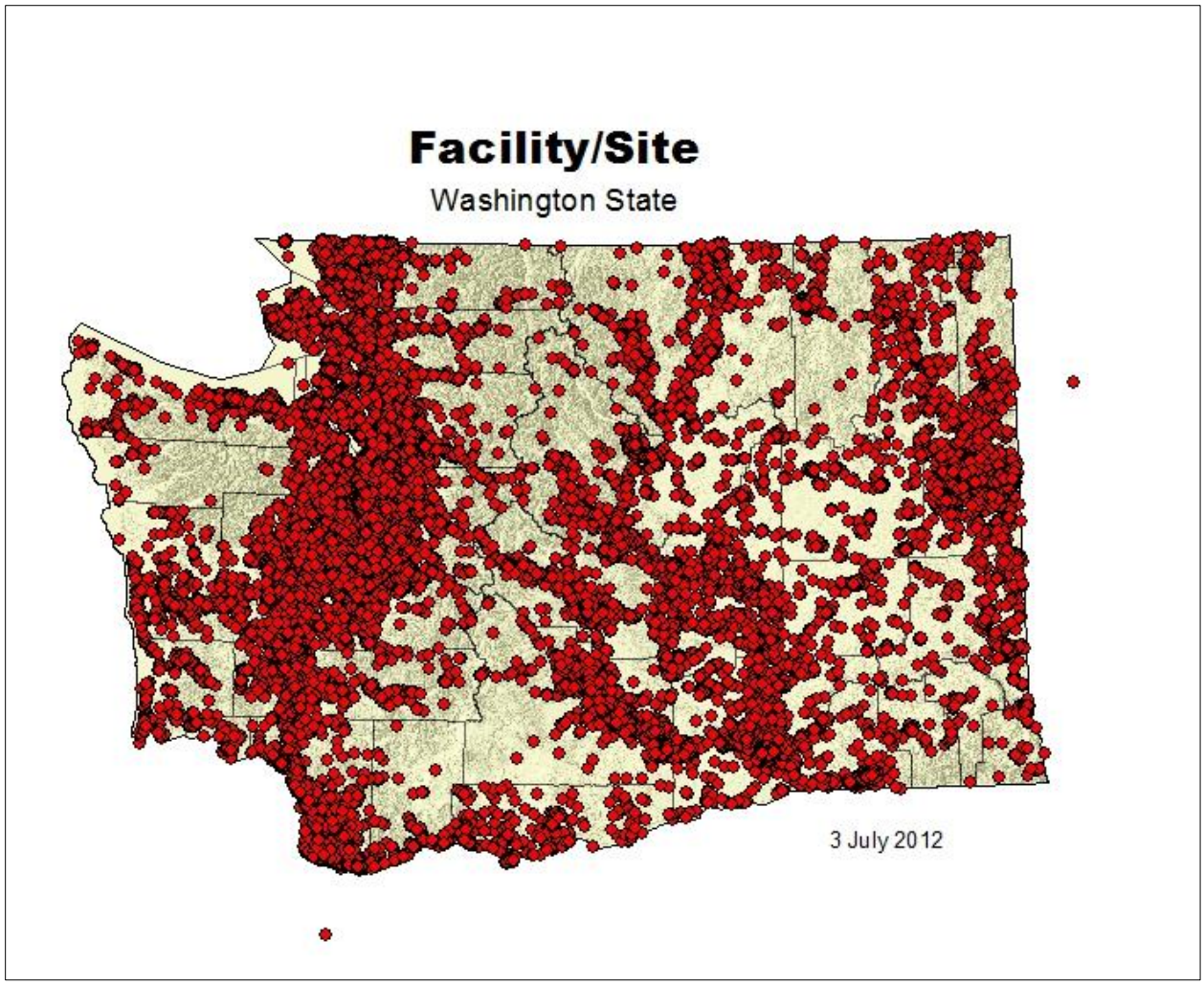


Figure 19 Locations of Facilities and Sites with Hazardous Chemicals

In an effort to help citizens, government, and industry better prepare for emergency response to chemical releases, the Washington State Emergency Response Commission (SERC) assembles and disseminates Tier Two data for facilities covered under the federal Community Right-to-Know laws. Reporting thresholds are: 10,000 pounds of a *hazardous substance* at any one time, and 500 pounds or less of an *extremely hazardous substance*. The graphic below indicate the total number of Tier Two reporting facilities and reportable substances by county for 2012 for hazardous substances.

Specific Washington Laws Relating to Hazardous Materials include: RCW 90.56 – *Oil and Hazardous Substance Spill Prevention and Response;* RCW 88.46 – *Vessel Oil Spill Prevention and Response;* RCW 90.48 – *Water Pollution Control;* RCW 88.40 – *Transport of Petroleum Products – Financial Responsibility;* RCW 70.105 – *Hazardous Waste Management; and* RCW 70.105D – *Hazardous Waste Cleanup – Model Toxics Control Act.*

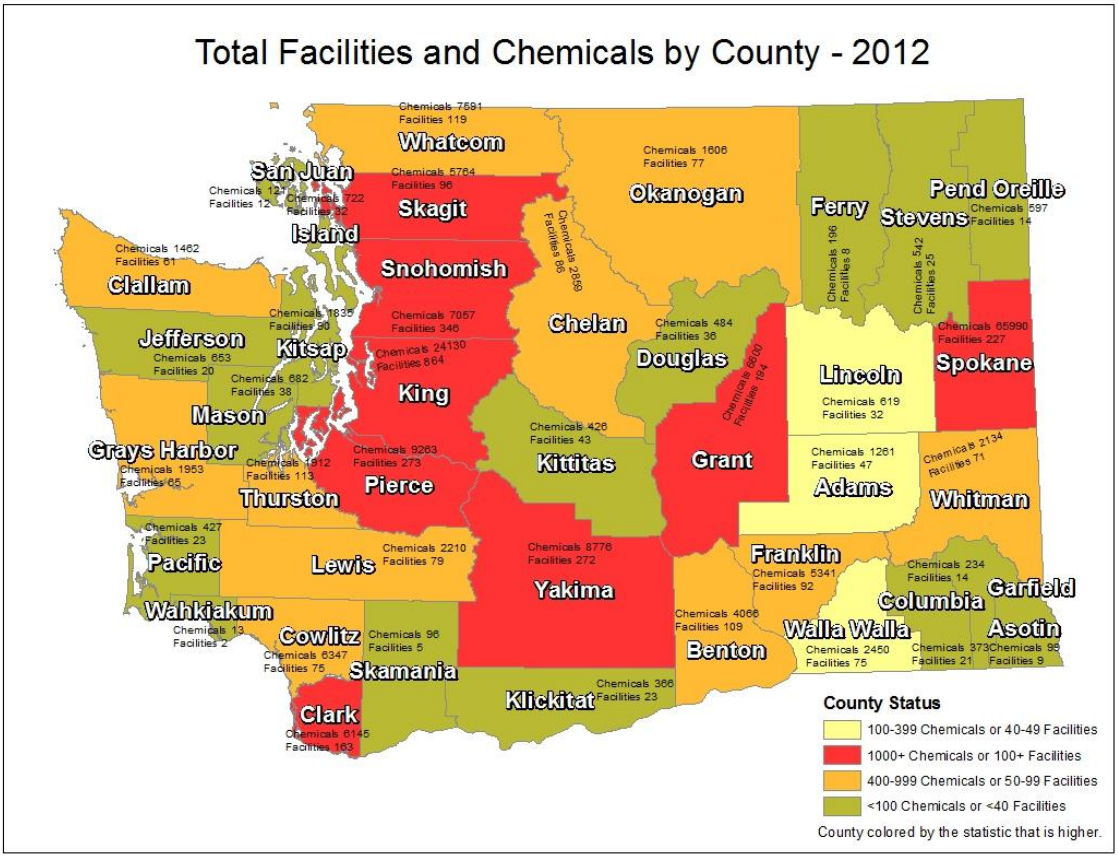


Figure 20 County HazMat Facilities and Chemicals

On January 16, 2013, U.S. Environmental Protection Agency (EPA) released its 2011 Toxics Release Inventory Report. The TRI National Analysis is an annual report that provides EPA's analysis and interpretation of the most recent TRI data. It includes information about toxic chemical releases to the environment from facilities that report to the TRI Program. It also includes information about how toxic chemicals are managed through recycling, treatment, and energy recovery, and how facilities are working to reduce the amount of toxic chemicals generated and released. The 2011 report includes geo-specific analyses for urban communities (Seattle-Bellevue-Tacoma metropolitan area), large aquatic ecosystems (Puget Sound Georgia Basin and Columbia River Basin), Indian County and Alaska Native Villages (Tulalip Tribes), and state fact sheets. See http://www.epa.gov/tri/tridata/tri11/nationalanalysis/.

An excerpt from the Urban Communities Analysis: The Seattle-Tacoma-Bellevue, WA metropolitan statistical area in the Puget Sound region of Washington is composed of King, Snohomish, and Pierce counties. With a population of 3.5 million, it is the 15th largest U.S. metropolitan statistical area. Other cities in the Seattle metropolitan area include Tacoma, Bellevue, Everett, Kent, Renton, and Auburn.

Economic activity within the metropolitan area includes the manufacturing of aircraft, ships, biomedical products, forest products, seafood products, aluminum, steel, textiles, clothing, electronics, and metal and glass products. In addition, the Port of Seattle is a major port city for trans-Pacific and European trade and is the fifth largest container port in the United States.

Air releases accounted for 83% of total on-site disposal or other releases in the Seattle metropolitan area during 2011. The paper products sector reported 55% of the total air releases, mainly composed of hydrochloric acid and methanol. This sector also accounted for more than 99% of chemicals discharged to surface water, mainly nitrate compounds and methanol. One pulp and paper mill accounted for 44% of all air releases and 59% of all surface water discharges reported by facilities in the Seattle metropolitan area.

To help emergency responders become aware of the possible chemicals they may encounter at the locations of an incident, the U.S. Department of Transportation has established a hazardous materials placard system. Railroad cars and trucks carrying chemicals or hazardous wastes must display a diamond-shaped placard which includes a material identification number, a hazard class number and symbol, which identifies the material as a flammable liquid or solid, non-flammable or flammable gas, explosive, corrosive, toxic, oxidizer or organic peroxide, environmentally hazardous, or radioactive material.

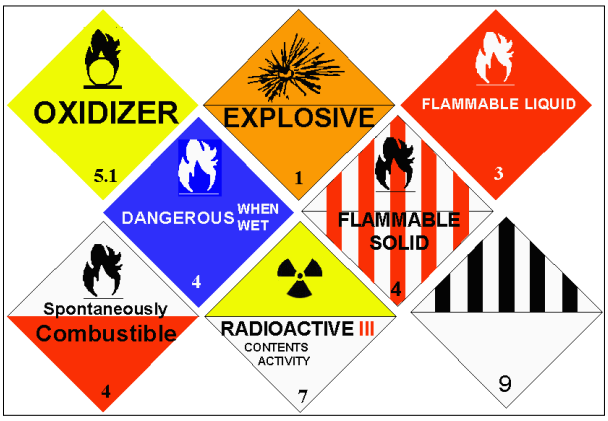


Figure 21 U.S. Department of Transportation

The Washington State Emergency Management Alert and Warning Center monitors various state and national alert systems besides tracking emergency incidents like hazardous materials (hazmat) spills. Hazmat incidents accounts for over half of the 2011 statistics below.

2011 Reported Incidents by County
Table 7: State AWC Duty Officer/Reports/2011/Year End Statistical Report Spreadsheet

COUNTY	FIRE	HAZMATS	OTHER	PHONE	SAR	WEATHER	TOTAL
Adams		7	1	1	1		10
Asotin		2			2		4
Benton		32	29	1	22		84
Chelan	28	13	1		49		91
Clallam	2	49	9	1	8		69
Clark	6	199	35		14		254
Cowlitz	9	75	12		55		151

Columbia		4		2	4		10
Douglas	4	8	1				13
Ferry	12	2			8		22
Franklin		15	1		5		21
Garfield	1	8			2		11
Grant	3	24	4		8		39
Grays Harbor	10	45	2	6	7		70
Island	1	35	1		4		41
Jefferson	4	28	2	1	3		38
King	1	670	73		121		865
Kitsap	1	103	19		14		137
Kittitas	46	13		1	17		77
Klickitat	16	21	2		16		55
Lewis	2	13	4	3	5		27
Lincoln	3	4					7
Mason	9	19	3		13		44
Okanogan	40	5	6	1	21		73
Pacific	3	64	2	1	16		95
Pend Oreille	11	2	1		6		20
Pierce	1	249	77	1	37		365
San Juan	2	25	4	2	3		36
Skagit	10	88	159	18	30		305
Skamania	10	14	3	1	40		68
Snohomish	9	164	34	1	95		303
Spokane	9	47	8	1			65
Stevens	46	7	2		5		60
Thurston	2	75	17		11		105
Wahkiakum	2	9					11
Walla Walla	1	15	3		2		21
Whatcom	8	250	230		39		527
Whitman	1	4			3		8
Yakima	12	42	3	1	35		93
Total	325	2450	755	44	736	42	4372

Spills 397F[35], 398F[36], 399F[37],400F[38],401F[39],402F[40],403F[41],404F[42]

In Washington State over 20 billion gallons of oil and hazardous chemicals are transported by ship, barge, pipeline, rail, and road each year. Equipment failure and human error in these situations can lead to oil and chemical spills that threaten public health and wildlife, contaminate the environment, and ultimately damage the state's economy and quality of life.

The Department of Ecology's Spill Prevention, Preparedness, and Response Program works to protect Washington's environment, public health, and safety through a variety of methods aimed first at preventing, but also by responding to spills when they do occur. Spill prevention actions include establishing a stricter oil transfer program for commercial maritime operations, increasing refinery, pipeline, and vessel inspections, and stationing a government-funded rescue tug at Neah Bay to aid disabled vessels through emergency towing and salvage services. Ecology's spill response capability is maintained 24-hours-a-day and 7-days-a-week throughout the State. Ecology continues to receive over 4,000 spill reports annually.

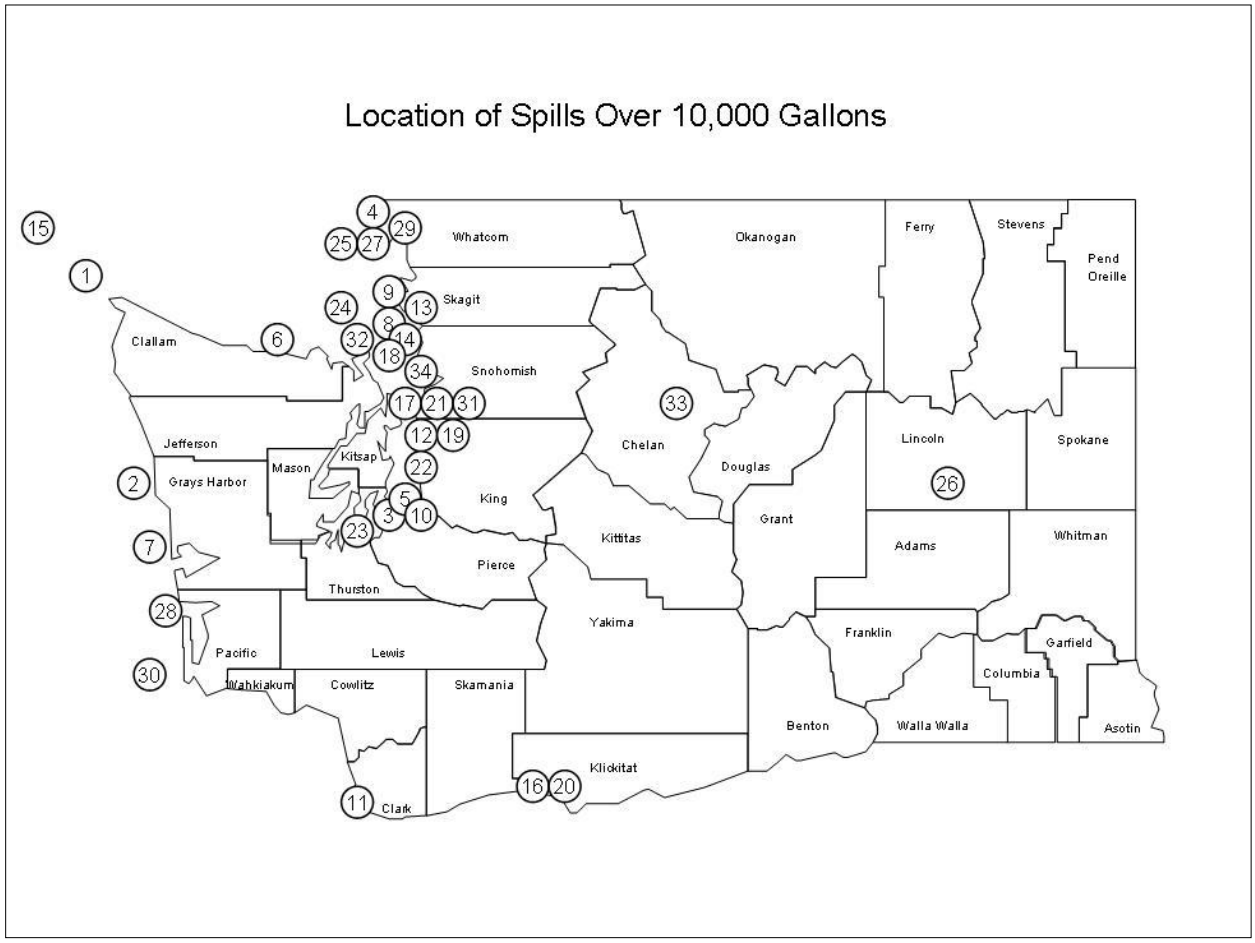


Figure 22 Oil Spills in Washington State A Historical Analysis.

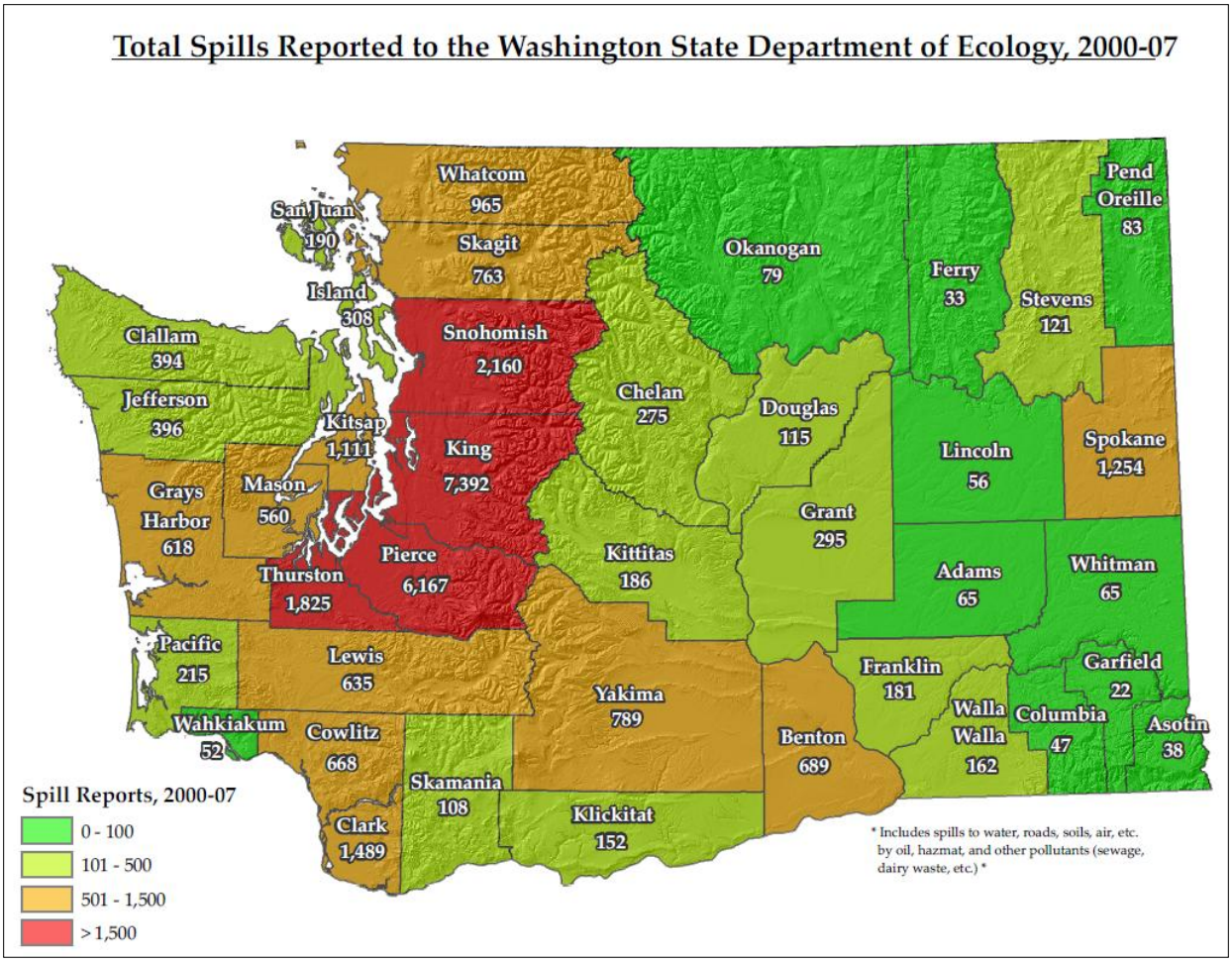


Figure 23 Total Spills Reported

Clandestine Methamphetamine Labs and Dump Site Cleanup Activity [43, 44, 45]

Illegal drug labs encountered by state and local agencies increased dramatically from 38 in 1990 to 1,890 in 2001 at its peak, to 92 in 2010. Ecology is responsible for handling and disposing of hazardous substances found at illegal drug lab sites. Nearly all of Washington's clandestine drug labs manufacture methamphetamine – also called *meth*, *crystal*, *crank*, or *speed*. Law enforcement intelligence indicates the recent decline may correspond with inexpensive drugs manufactured in Mexico and entering the United States.

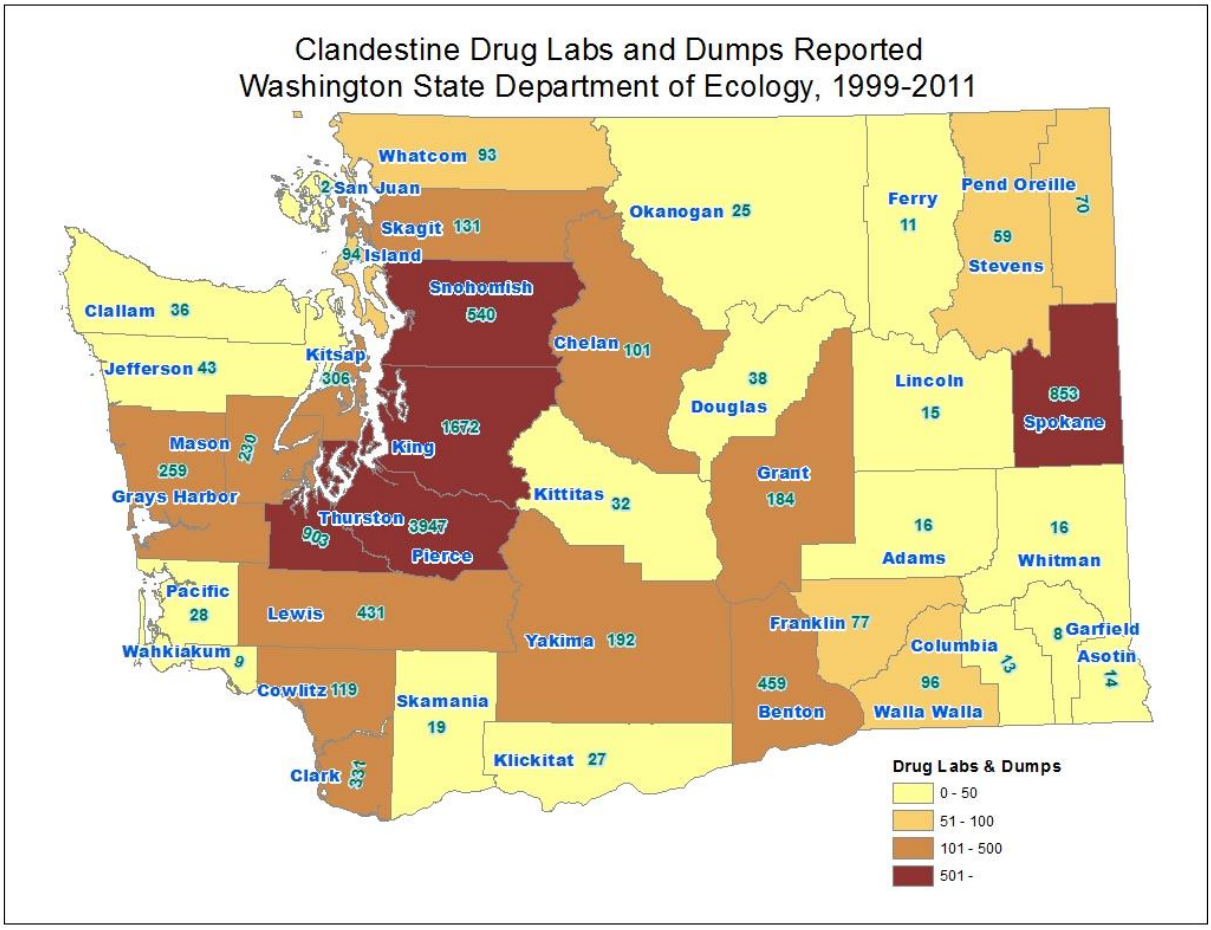


Figure 24 Clandestine Drug Lab and Dumps Reported by County

Radioactive Materials [46, 47]

The Washington State Department of Health licenses nearly 400 facilities in the state that use radioactive materials. These are categorized in three major groups: medical, industrial, and laboratory. Hospitals, clinics, laboratories, and research facilities routinely use radiation in the diagnosis and treatment of medical and dental patients. Industrial applications include various flow gauges, research and development facilities, and radiography to non-destructive test welds and castings for flaws. Additionally, military bases that receive, ship, and store nuclear materials include Puget Sound Naval Shipyard at Bremerton, Naval Submarine Base Bangor, Joint Lewis-McChord Base, and Fairchild Air Force Base. A specific Department of Health license is required to receive, possess, use, transfer, or acquire

most radioactive materials. Licensees and registrants are periodically inspected for regulation compliance, material use and handling, personnel training, security, transportation, and other important factors that correspond with the possession of radiological materials.

There are five major types of ionizing radiation with various penetration abilities.

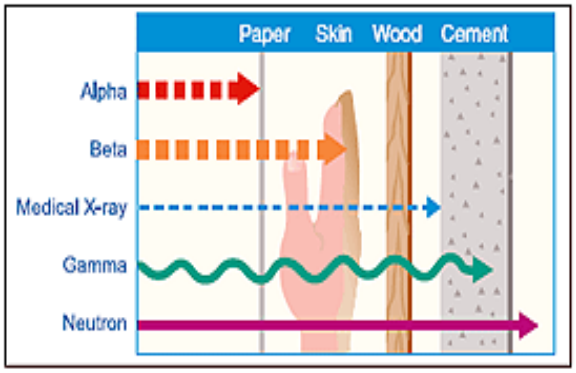


Figure 25 Ionizing Radiation Abilities

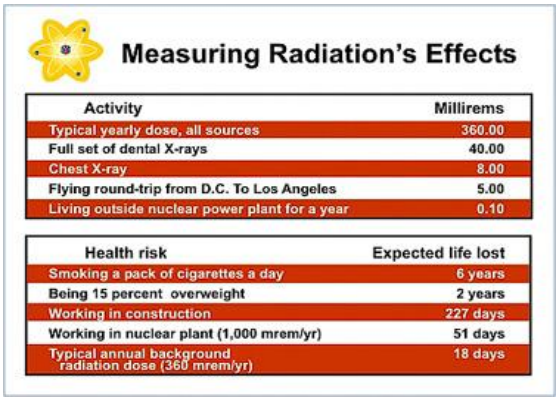


Figure 26 Radiation Exposure Levels and

The *Integrated Fixed Facility Radiological and Chemical Protection Plan* (IFFRCPP) maintained by the Washington State Emergency Management Division provides guidance to state agencies in the event of a chemical or radiological material incident. For radiological incidents, this plan covers incidents that may occur at the DOE-Hanford radiological waste storage facility, Energy Northwest's Columbia Generating Station nuclear power plant, and for the U.S. Navy bases that are located in and around the Puget Sound region. This plan includes emergency and notification procedures, emergency planning zones and protective action guidelines for both the CGS and Hanford-DOE areas.

Fukushima Tsunami and Nuclear Reactor [48], [49]

On March 11, 2011, an earthquake in Japan was followed by a devastating tsunami that severely damaged three of the six nuclear reactors located at Fukushima. Shortly thereafter, the Washington State Department of Health added to its routine monitoring and began reporting daily readings of radiation around the state. On March 16, 2011 the Department of Health detected radioactive materials from Fukushima. Specific state health testing for radioactive materials from the damaged nuclear plants at Fukushima have consistently shown all levels have been well below any health concern for people living in Washington.

Monitoring for radioactive contamination in our environment continues throughout the state. The Environmental Protection Agency's (EPA) RadNet samplers are taking readings as they did before the earthquake. They returned to routine sampling schedule on May 3, 2011.

Table 7 Background Radiation Results 2010 - 2012

Location	**Most recent**	**Last 2011 number** May 24, 2011	**April 2011 Average**	**April 2011 Highest**	**April 2011 Lowest**	**2010 Average**	**2010 Highest**	**2010 Lowest**
Richland	no data	no data	*	*	*	*	*	*
Seattle	14	9	14	41	7	*	*	*
Spokane	51	51	50	136**	13	92	841	13
Tumwater	25	17	21	61	7	25	155	5

Gross beta radiation in air sampling devices. http://www.epa.gov/radnet/radiation-monitoring/index.html
*Environmental Protection Agency (EPA) monitor out of service.
**The reading originally published for April 2011 was incorrect. The number has been corrected.

The National Oceanic and Atmospheric Administration (NOAA) and other federal agencies are tracking the debris washed into the ocean by the tsunami in Japan. Small amounts of tsunami debris began washing up on the West Coast of the United States and British Columbia in late spring 2012. The Washington State Department of Health has already field-tested hundreds of items from beaches in our state and found no radioactive contamination. State Scientists agree that finding radioactive debris is very unlikely for several reasons: 1) the tsunami created debris from a large stretch of Japan's coast, but the leak from the damaged Fukushima reactor occurred in one place. Most of the debris was many miles away from the reactor so it had no contact with the radioactive leak; 2) the leak of contaminated water from the reactor started days to weeks after the tsunami debris had washed out to sea. By the time the radioactive water leak developed, the debris was already in the ocean, miles away from the reactor; and 3) Ships, boats, and cargo coming into the United States from Japan were monitored for radiation, and readings were below the level of concern.

The Washington State Marine Debris Response Plan is designed to give local, tribal, state, and federal responders flexibility in rapidly assessing a high-impact debris item and identifying which agencies will respond and what resources will be needed to protect public health, safety and the environment. The plan is designed to coordinate rapid responses to marine debris of significant impact – particularly items that are large, contain hazardous substances such as oil or toxic chemicals, or pose invasive species concerns.

The plan also is tailored to address the steady response to a potential influx of more routine, nonhazardous debris by supporting ongoing local community efforts – traditionally undertaken by dedicated volunteers – to remove these items. The plan calls for supporting these beach cleanup efforts such as providing volunteers litter bags and access to trash bins. If debris amounts overwhelm local efforts, crews from the Washington Department of Ecology's Washington Conservation Corps can be

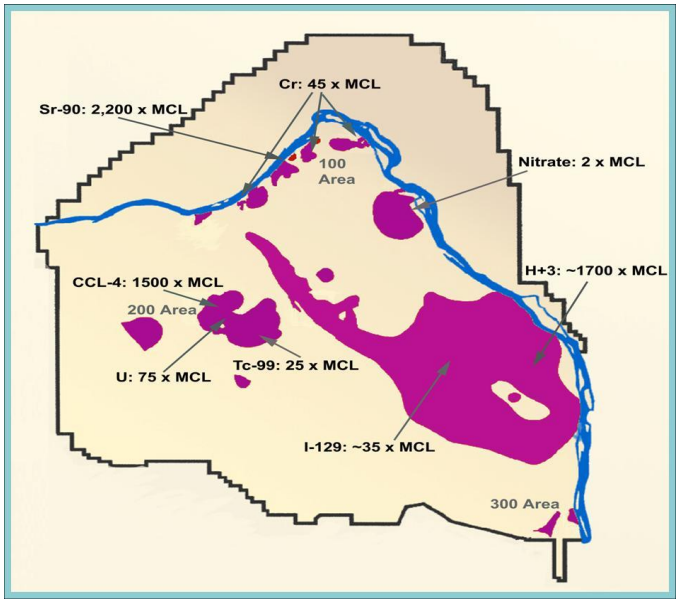
dispatched. The state marine debris response plan will continue to evolve over time and adapt to changing conditions.

Hanford Nuclear Reservation[50,51,52]

The Hanford Nuclear Reservation was built by the US government in 1943 as the home for the Manhattan Project, the wartime effort to build the atomic bomb. The 560 square mile site bordering 51 miles of the Columbia River near the cities of Richland, Pasco, and Kennewick, Washington, is the most contaminated site in North America, holding more than 60 percent of the nation's highly radioactive and chemically hazardous wastes. These 53 million gallons of high level radioactive hazardous wastes are stored in 177 underground tanks, 149 of which are leak-prone, single-shelled tanks posing a serious threat to the land, the nearby Columbia River, human health and the region's economy. Already, 67 of the single-shelled tanks have leaked about one million gallons of highly toxic contaminants into the ground and are moving through groundwater toward the Columbia River. In 2008, it was estimated that if cleanup does not proceed on schedule, the contamination will reach the Columbia River in 12 to 50 years depending on the specific location and type of contamination.

Approximately one million people live in the 42 cities and towns downstream from the Hanford site. About 8,000 farms worth an estimated $6.4 billion are located in and around these communities. The region contributes to 10 percent of Washington's overall economy and 30 percent of Oregon's economy.

The most recent significant release of radioactive hazardous waste at the Hanford Nuclear Reservation tank farm was on July 27, 2007. Contractor CH2M Hill Hanford Group was pumping waste from a single-shell tank and tried to unblock the pump by running it in reverse when "Over 80 gallons of highly radioactive tank waste spilled," according to the manager of Ecology's Nuclear Waste Program. Upon investigating the circumstances around the spill, Ecology determined a series of administrative and engineering failures contributed to the accident including inadequacies in the design of the waste retrieval system.



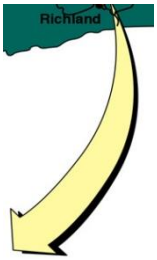


Figure 27 Combined Chemical and Radiological Groundwater Contamination (purple areas) Above Drinking Water Standard: Approximately 80 square miles

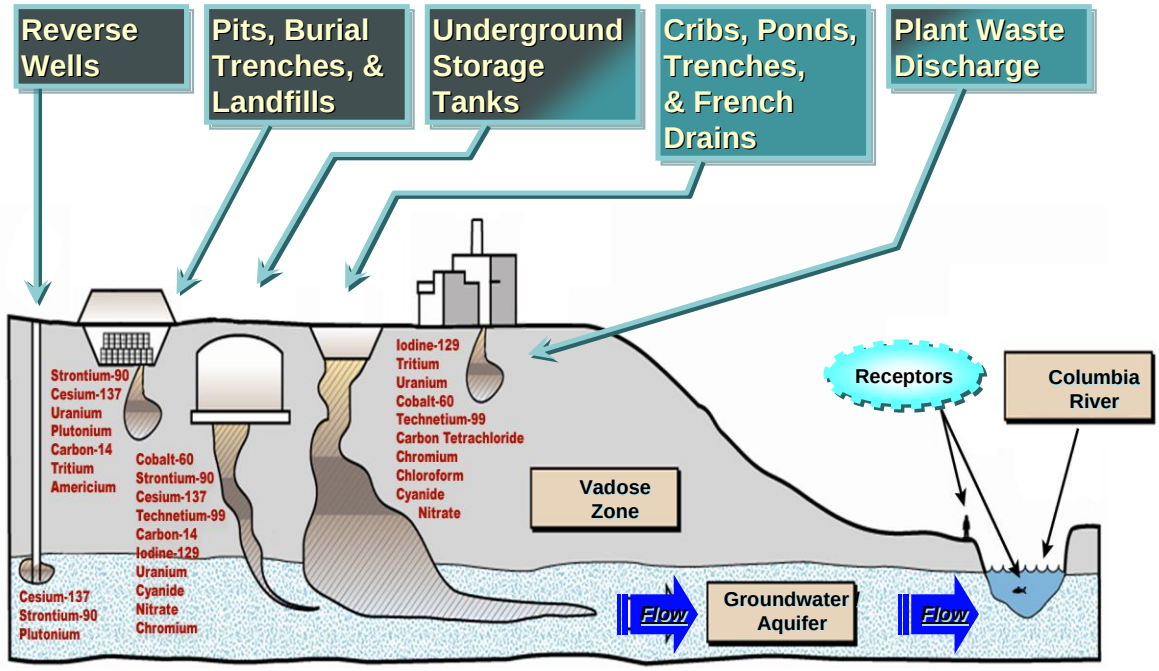


Figure 28 Hanford Sources of Contamination

Columbia Generating Station[53]

The Columbia Generating Station (CGS) is located on the Hanford Reservation 6 miles north of Richland and 2 miles west of the Columbia River. Energy Northwest's CGS is Washington's only operating commercial nuclear power plant. CGS is a boiling water reactor and produces 1,150 megawatts of electricity – enough to meet the needs of a city the size of Seattle. This electricity is sold at cost to Bonneville Power Administration (BPA).

CGS is a reliable energy producer. Unlike hydro, wind, and solar generation facilities, CGS is not dependent on weather conditions — it will produce electricity 24 hours a day, 7 days a week. In addition, operators are able to adjust power levels to meet Bonneville Power Administration's needs based on river and wind conditions referred to as "load following." Refueling and maintenance outages occur every two years during the spring, when the Columbia River Basin has ample runoff to generate electricity through hydroelectric turbines.

Five commercial reactors were initially planned for the State by the Washington Public Power System, but Units 4 and 5 were cancelled in 1982. Units 1 and 3 were cancelled in 1995. Construction of Unit 2 began in 1972, but more than a decade passed before it began generating power. Since the retirement of Oregon's Trojan Nuclear Plant, it is the only fully licensed commercial reactor in the northwestern United States. In 2000, Washington Public Power System changed its name to Energy Northwest and the plant's name to the Columbia Generating Station. It has a license to operate through 12/20/2023.

There have been several worldwide nuclear release accidents but there have been no incidents of radiological release at the Columbia Generating Station. A list of some of the minor incidents that have occurred at CGS is below.

Date	Table 8 Incident Description	Notification Level
14 May 1997	**Explosion at the Plutonium Reclamation Facility (200 West Area)**	**Alert**
28 January 1998	**Picric Acid crystals found in 327 building (300 Area)**	**Alert**
28 June 2000	**24 COMMAND Range Fire (started in Benton County and came on-site. Threatened multiple facilities throughout the Hanford Site)**	**Alert**
24 August 2005	**Solid Waste Storage and Disposal Facility incident(200 West Area)**	**Alert**
25 June 2004	**Radiography vehicle stolen, vehicle later recovered**	**Alert**
30 July 2004	**Failure of two control rods to properly insert into the reactor**	**Alert**
6 November 2005	**Fast Flux Test Facility (FFTF) incident (400 Area)**	**Alert**
28 March 2006	**Range brush fire threatened the protected area near CGS**	**Alert**

Table 6 Minor incidents that have occurred at CGS in recent history

The primary concern at the Columbia Generating Station is a potential release of radiological material. To ensure the likelihood is minimized, there are emergency plans in place and annual exercises conducted. In addition safety inspections are performed at the plant to ensure proper operation and safety procedures are followed.

Benton County Emergency Services, in coordination with Franklin County Emergency Management, the State of Washington, and Energy Northwest have developed plans to respond in the event of an accident at CGS. These plans are designed to help protect area residents, specifically those living within the Emergency Planning Zones (EPZ) around the nuclear power plant.[54] These plans are reviewed and updated routinely.

Two EPZs have been established as a basis for preparing to protect the public. Emergency plans for residents living up to ten miles from a nuclear facility, the plume EPZ, include ways to protect them from direct exposure to radiation in the event of a release of radioactive material.

Persons located up to fifty miles from a nuclear facility reside in the ingestion EPZ (Figure 2-5). Emergency plans for those in the ingestion EPZ include ways to protect them from consuming contaminated food. Examples of food or drink that can become contaminated with radiation are milk, fresh fruits, vegetables, processed products, and open water sources.[55]

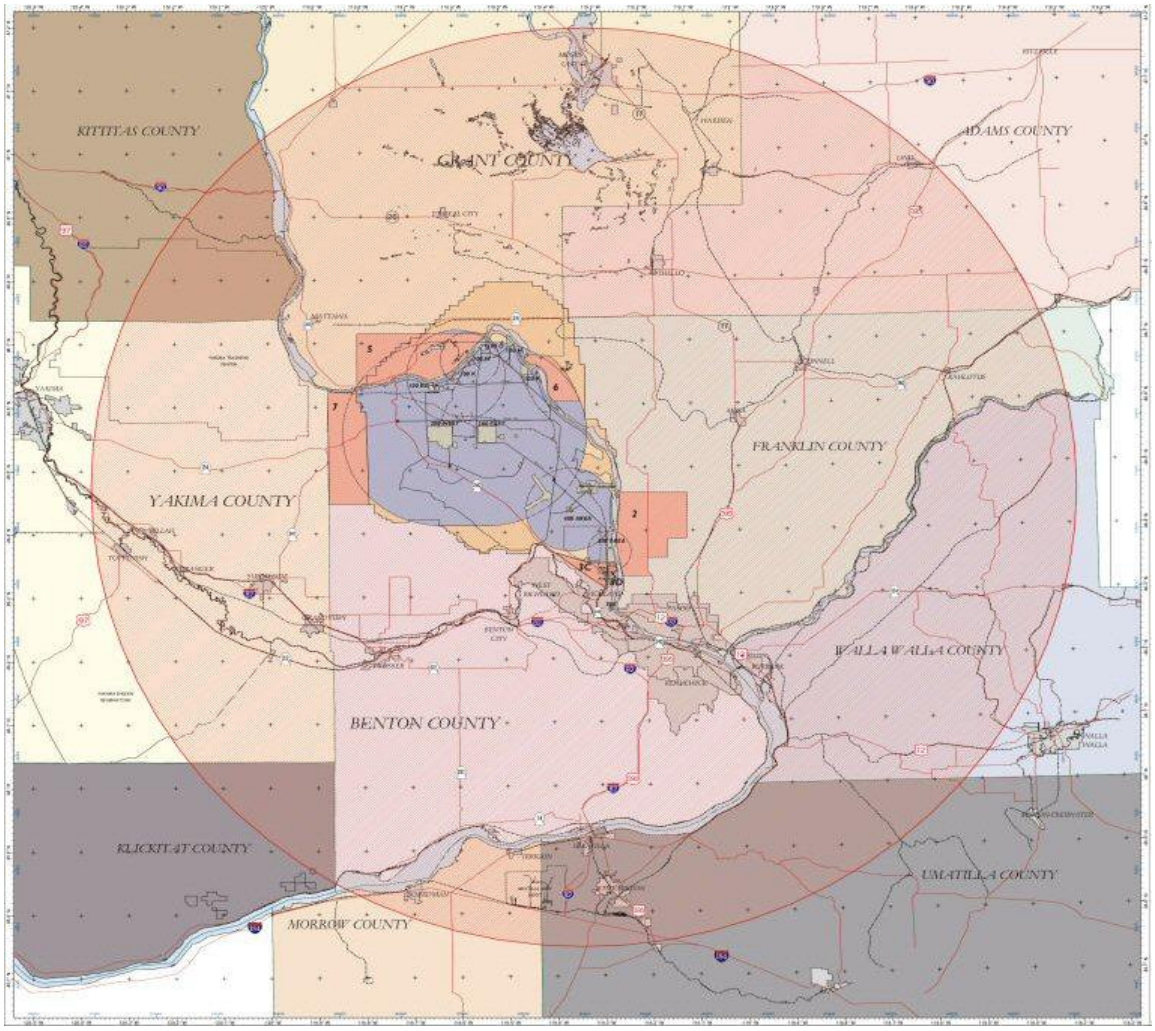


Figure 29 50-Miles Ingestion Emergency Planning Zone

Washington Cleanup Sites [56]

The Commencement Bay Nearshore-Tideflats Superfund site is located in the City of Tacoma and the Town of Ruston at the southern end of Puget Sound in Washington. It encompasses an active commercial seaport and includes 12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The United States Environmental Protection Agency (EPA) placed the site on the Superfund National Priorities List in 1983 due to widespread contamination of the water, sediments, and upland areas.

The U.S. Department of Energy Hanford Site, located near the City of Richland, Washington, was established to produce nuclear materials for national defense. The Hanford Site was placed on EPA's Superfund National Priorities List of contaminated sites in 1989.

The Lower Duwamish Waterway Superfund Site is a 5.5 mile stretch of the Duwamish River that flows into Elliott Bay in Seattle, Washington. The waterway is flanked by industrial corridors, as well as the South Park and Georgetown neighborhoods. The site was added to EPA's Superfund National Priorities List in 2001.

Table 9 Washington State Cleanup Sites

City ▲	Title ▲	Type of Site ▲
Vancouver	Alcoa Smelter	Deleted NPL
Twisp	Alder Gold and Copper Mill	Removal
Benton County	Alexander Farms, Benton County, WA	Removal
Chehalis	American Crossarm & Conduit Co.	NPL
Leadpoint	Anderson-Calhoun Mine and Mill	Removal
Tacoma	Asarco Smelter - Ruston	Part of NPL site
Silverdale	Bangor Naval Submarine Base	NPL
Silverdale	Bangor Ordnance Disposal (USNAVY)	NPL
Seattle	Basin Oil	Removal Assessment
Seattle	Boeing Electronics Manufacturing Facility (EMF) Superfund Site	Removal
Marysville	Boeing Tulalip Test Site	NPL Equivalent
Colville	Bonanza Mill	Site Assessment
Vancouver	Boomsnub-AIRCO	NPL
Vancouver	Boomsnub 2001 Removal	Removal
Bellevue	BP Tank Truck Accident - Bellevue	Oil
Bremerton	Bremerton Gasworks Site	Oil
	Brownfields and Washington State	Brownfields
Vancouver	Camp Bonneville Site	BRAC
Centralia	Centralia Municipal Landfill	NPL
Tacoma	CleanCare Removal Site	Removal
Chehalis	Coal Creek - Ross Electric	NPL Equivalent

Colbert	Colbert Landfill	NPL
Colville	Colville Post and Poles, Inc.	Removal
Tacoma	Commencement Bay-Nearshore Tideflats	NPL
Tacoma	Commencement Bay-South Tacoma Channel	NPL
Vancouver	Dorothy Avenue Mercury Site	Response
Reardan	Euclid Road Groundwater Site	Removal
Spokane	Fairchild Air Force Base (4 Waste Areas)	NPL
Yakima	FMC Corp. Yakima Superfund Site	NPL
Fort Lewis	Fort Lewis Logistics Center	NPL
Fort Lewis	Fort Lewis (Landfill No. 5)	Deleted NPL
Vancouver	Frontier Hard Chrome, Inc.	NPL
Spokane	General Electric Co. (Spokane Shop)	NPL
	Grandview Pesticide Fire	Removal
Spokane	Greenacres Landfill	NPL
Chehalis	Hamilton-Labree Roads Groundwater Contamination	NPL
North Bonneville	Hamilton Island Landfill (USA/COE)	Deleted NPL
Richland	Hanford - Washington	NPL
Richland	Hanford 100-Area (USDOE)	NPL
Richland	Hanford 1100-Area (USDOE)	Deleted NPL
Richland	Hanford 200-Area (USDOE)	NPL
Richland	Hanford 300-Area (USDOE)	NPL
Seattle	Harbor Island (Lead)	NPL
Puyallup	Hidden Valley Landfill (Thun Field)	NPL
Chelan	Holden Mine	Mining
Bothell	Horse Creek Mystery Spill	Removal
Tacoma	Hylebos Waterway	Part of NPL site
Issaquah	Issaquah Mini-Storage Response	Response
Bremerton	Jackson Park Housing Complex (USNAVY)	NPL
Kent	Japanese Auto Wrecking	Removal
Seattle, Washington	Jorgensen Forge Early Action Area	Part of NPL site
Skyway	Junior's Trucking Tire Fire	Response
Nighthawk	Kaaba-Texas Mine Removal, Nighthawk, WA	Removal
Mead	Kaiser Aluminum Mead Works	NPL
Enumclaw	Koopman Dairy	Removal
Lake Tapps	Lake Tapps Abandoned Drums	Response
Seattle	Lake Washington Dry Docks	Response
Lakewood	Lakewood Site	NPL
Northport	Le Roi Smelter	Removal

Seattle	Lockheed West Seattle	NPL
Seattle	Lower Duwamish Waterway Superfund Site	NPL
Seattle	Malarkey Asphalt Company	Removal
Mica	Mica Landfill	NPL
Tacoma WA	Middle Waterway	Part of NPL site
Wellpinit	Midnite Mine Superfund Site	NPL
Kent	Midway Landfill	NPL
Moses Lake	Moses Lake Wellfield Contamination Superfund Site	NPL
Keyport	Naval Undersea Warfare Center (4 Areas)	NPL
Spokane	North Market Street	NPL
Spokane	Northside Landfill	NPL
Everson	Northwest Transformer (Mission Pole)	Deleted NPL
Everson	Nortwest Transformer (South Harkness Street)	Deleted NPL
Bellingham	Oeser Company	NPL
Spokane	Old Inland Pit	NPL
Manchester	Old Navy Dump/Manchester Lab (USEPA/NOAA)	NPL
Renton	Olympic Pipeline Sample Line Gasoline Spill	Oil
Tacoma	Olympic View Removal Action and Monitoring	Part of NPL site
Renton	Pacific Car and Foundry (PACCAR)	NPL
Seattle	Pacific Sound Resources	NPL
Tumwater	Palermo Well Field Groundwater Contamination	NPL
Pasco	Pasco Sanitary Landfill	NPL
Yakima	Pesticide Lab (Yakima)	Deleted NPL
Fidalgo Island	PM Northwest Removal Site	Removal
Bremerton	Puget Sound Naval Shipyard Complex	NPL
Maple Valley	Queen City Farms	NPL
Renton	Quendall Terminals	Site Assessment
	RCRA Corrective Action Sites in Washington	RCRA CA
Seattle	Rhone-Poulenc Incorporated	RCRA CA
SeaTac	SeaTac Oilspill	Oil
Kent	Seattle Municipal Landfill (Kent Highlands)	NPL
Loomis	Silver Mountain Mine	Deleted NPL
Spokane	Spokane Junkyard and Associated Properties	Deleted NPL
Whatcom County	Sumas Mountain Asbestos Documents	Site Assessment
Whatcom County	Swift Creek Asbestos Site	Site Assessment
Tacoma	Tacoma Tarpits	Part of NPL site
Tacoma	Thea Foss Abandoned Drums	Removal
Tacoma	Thea Foss, Wheeler-Osgood Waterway	Part of NPL site
Brush Prairie	Toftdahl Drums	Deleted NPL

Marysville	Tulalip Landfill	Deleted NPL
	Upper Columbia River Site Study	Remedial
Tacoma	US Oil Jet Fuel Spill	Oil
Tacoma	USAF McChord AFB American Lake Gardens	NPL
Tacoma	USAF McChord Air Force Base (Wash Rack Treatment Area)	Deleted NPL
Vancouver	USDOE BPA Ross Complex	Deleted NPL
Oak Harbor	USNAVY Naval Air Station, Whidbey Island (Ault)	NPL
Oak Harbor	USNAVY Naval Air Station, Whidbey Island (Seaplane)	Deleted NPL
Port Hadlock	USNAVY Port Hadlock Detachment Naval Ordnance Ctr Pac Div	NPL
Vancouver	Vancouver Water Station #1 Contamination	NPL
Vancouver	Vancouver Water Station #4 Contamination	NPL
Spokane	Vermiculite Northwest - Spokane WA	Site Assessment
Seattle	West Waterway Tributyltin (TBT)	Part of NPL site
Kent	Western Processing Company, Inc.	NPL
Longview	Weyerhaeuser Oil Tank	Oil
Bainbridge Island	Wyckoff Eagle Harbor	NPL
Yakima	Yakima Plating Company	Deleted NPL
Yakima	Yakima Reservation Pesticide Dump	Response
Yakima	Yakima Residential Mercury Release	Response

Figure 12 source:
http://yosemite.epa.gov/r10/cleanup.nsf/webpage/Washington+Cleanup+Sites!OpenDocument&Count=250&ResortAscending=1

Jurisdictions Most Threatened and Vulnerable to Hazardous Materials Hazards

Although Washington has a varied history of hazardous materials incidents including the unwanted, unplanned, or deliberate release or escape of explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, or radioactive substances that may cause or create a potential risk to public health, safety, or the environment, it is nevertheless very hard to predict. Determining future hazardous materials incidents is difficult because so many factors can contribute and there are so many different types of incidents. Nonetheless, hazardous materials incidents have impacted every county in the state.

Western Washington counties are more at risk due to dense industrial and populated areas and major transportation routes surrounding the fragile ecosystems of the Puget Sound and coastal waterways. The Westside has two Superfund sites while the Eastside has the Superfund site of Hanford. Although an analysis has not been conducted to determine the jurisdiction of greatest risk nor was there an attempt to estimate potential losses to state facilities due to hazardous materials incidents, Ecology has distributed its response equipment accordingly.

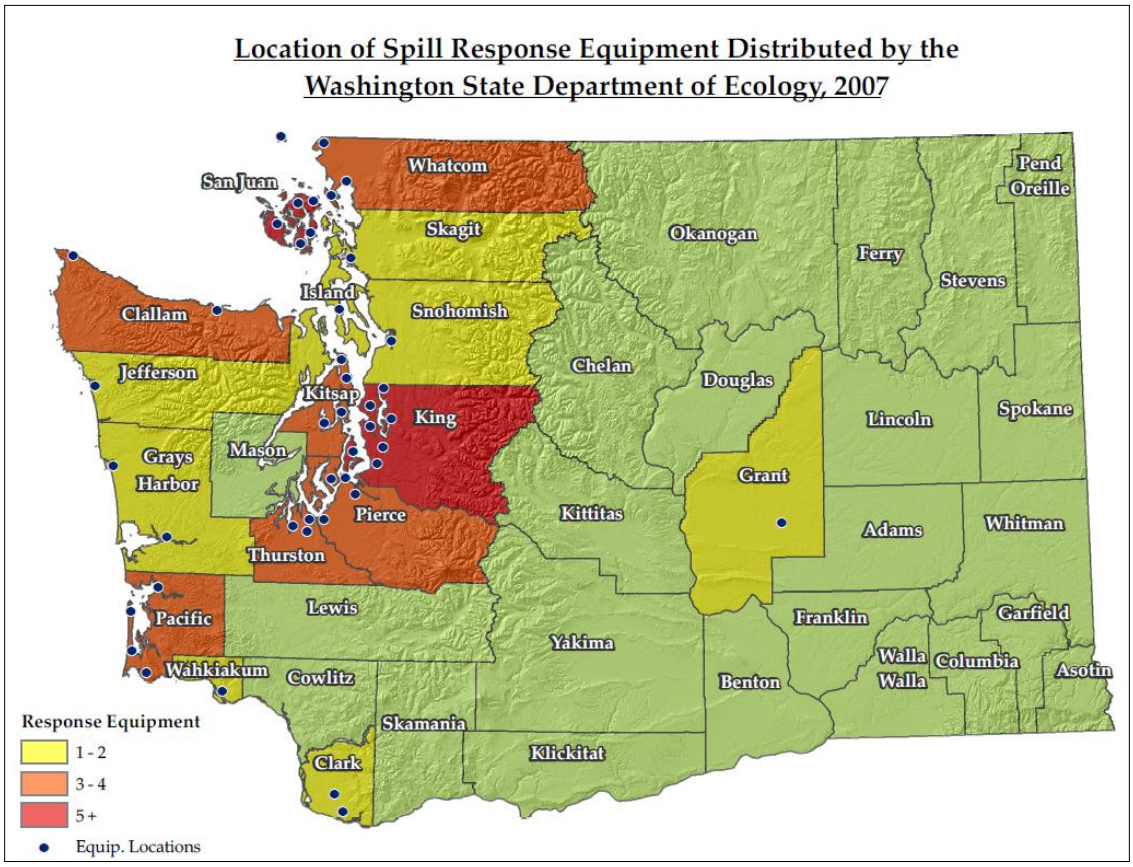


Figure 30 Location of Spill Response Equipment, Indirect Vulnerability Analysis

Potential Climate Change Impacts [57,58,59,60]

With the advent of climate change coming into worldwide focus; it is necessary to take into account the potential effects this emerging climate crisis may have on the dangers associated with tsunamis. The research done so far indicates the potential for unusual or more frequent heavy rainfall and flooding is greater is some areas while the potential for drought is predicted in other areas. Landslide frequency is correlated with heavy rainfall and flooding events. Sea level rise may impact inundation areas.

According to a 2005 Governor's report prepared by the Climate Impacts Group titled *Uncertain Future: Climate Change and its Effects on Puget Sound*, from "paleoclimatological evidence, we know that over the history of the earth high levels of greenhouse gas concentrations have correlated with, and to a large extent caused, significant warming to occur, with impacts generated on a global scale." While the report also indicates that the "ultimate impact of climate change on any individual species or ecosystem cannot be predicted with precision," there is no doubt that Washington's climate has demonstrated change.

In July 2007, the Climate Impacts Group launched an unprecedented assessment of climate change impacts on Washington State. *The Washington Climate Change Impacts Assessment* (WACCIA) involved developing updated climate change scenarios for Washington State and using these scenarios to assess the impacts of climate change on the following sectors: agriculture, coasts, energy, forests, human health, hydrology and water resources, salmon, and urban stormwater infrastructure. The assessment was funded by the Washington State Legislature through House Bill 1303.

In 2009, the Washington State Legislature approved the *State Agency Climate Leadership Act* Senate Bill 5560. The Act committed state agencies to lead by example in reducing their greenhouse gas (GHG) emissions to: 15 percent below 2005 levels by 2020; 36 percent below 2005 by 2035; and 57.5 percent below 2005 levels (or 70 percent below the expected state government emissions that year, whichever amount is greater.). The Act, codified in RCW 70.235.050-070, directed agencies to annually measure their greenhouse gas emissions, estimate future emissions, track actions taken to reduce emissions, and develop a strategy to meet the reduction targets. Starting in 2012 and every two years thereafter, each state agency is required to report to Washington State Department of Ecology the actions taken to meet the emission reduction targets under the strategy for the preceding biennium.

Recognizing Washington's vulnerability to climate impacts, the Legislature and Governor Chris Gregoire directed state agencies in 2009 to develop an integrated climate change response strategy to help state, tribal, and local governments, public and private organizations, businesses, and individuals prepare. The state Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Health, Natural Resources and Transportation worked with a broad range of interested parties to develop recommendations that form the basis for a report by the Department of Ecology: *Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy*.

Over the next 50 - 100 years, the potential exists for significant climate change impacts on Washington's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts could potentially include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Therefore, climate change has the potential to impact the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses. Recognizing the global, regional, and local

implications of climate change, Washington State has shown great leadership in addressing mitigation through the reduction of greenhouse gases.

It can be argued that hazardous material spills and chemical or radiological releases, whether from facilities or during transportation, can be associated with weather patterns and natural disasters but the climate change impact would be of a secondary nature. It may acerbate the problem but probably will not cause a release outright.

At Risk State Facilities

This profile will not attempt to estimate potential losses to state facilities due to hazardous materials incidents.

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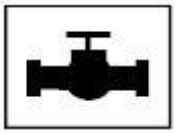
Pipelines

 Pipeline	**Frequency**	50+ yrs	10-50 yrs	1-10 yrs	Annually
	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
	Hazard scale			< Low to High >	

Risk Level

Frequency –A significant pipeline incident occurs in Washington approximately every 1 to 10 years.
People – Although people have been injured and killed by a pipeline incident, past incidents have not reached the minimum threshold for this category.
Economy- A pipeline incident can affect the major transportation routes throughout the State and could cause major disruption to movement of goods by truck, rail, and air; resulting in a major hit to the State's economy.
Environment – Although the environment and the species that inhabit these areas can be affected by a pipeline incident due to a spill of hazardous materials, it is not felt that such an incident will eradicate 10% of a single species or habitat.
Property – Based on past property damage of other states as a result of a pipeline incident, an incident occurring in a heavily populated area of the State could generate property damage in the range of $100-500 million dollars.

HIVA Risk Classification for Pipelines is 4B or Mitigation to Reduce Risk is Optional.

Hazard Area Map

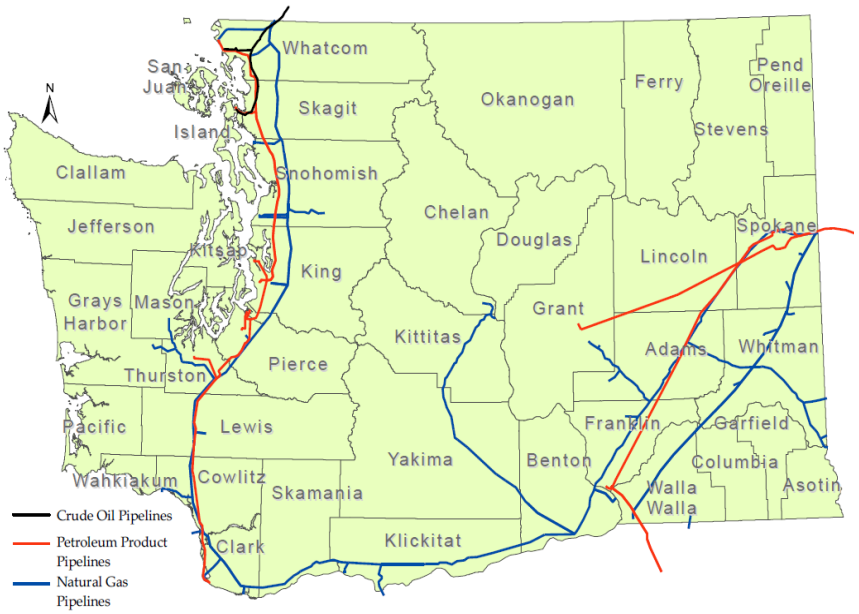


Figure 31: Washington State Pipeline Distribution Network. The location of pipelines carrying natural gas, petroleum products, and crude oil located within Washington State.

The Hazard [61], [62]

A pipeline is defined as a transportation artery that is capable of carrying liquid and gaseous fuels. Pipelines can be buried beneath the surface or can be placed above ground. Natural gas or hazardous liquid transmission pipelines run through 28 Washington counties and 119 cities. They lie buried at varying depths, carrying a range of volatile products and cross through a variety of land uses --from agriculture to urban centers. Most of the over 3,200 miles of transmission pipelines in Washington were constructed in farmland bypassing urban areas.

Washington State has the following types of pipelines: crude oil, petroleum products, and natural gas. These types of fuels are defined as:

Natural Gas – Underground deposits of gases consisting of 50 to 90 percent methane (CH_4) and small amounts of heavier gaseous hydrocarbon compounds such as propane (C_3H_8) and butane (C_4H_{10}).
Crude Oil – The term used to define petroleum as it comes directly out of the ground. It is a varied substance, both in its use and composition. It can be a straw colored-liquid or a tar-black or semi-solid. Red, green, and brown hues of crude oil are common.
Petroleum Products – Petroleum products is a generic name for hydrocarbons, including crude oil, liquid natural gas, natural gas, and their products. Petroleum products include; gasoline, kerosene, jet fuel, heavy fuel oil, diesel, petroleum jelly, and paraffin.

Crude oil and petroleum products travel in the hazardous liquid line while natural gas travels in the gas transmission and gas distribution lines.

Table 9 Washington State Pipeline Mileage Overview

Pipeline System	Mileage
Hazardous liquid line mileage	839
Gas transmission line mileage	1,954
Gas Gathering line mileage	0
Gas distribution mileage (1,238,807 total services [A])	21,577
Total pipeline mileage	24,370
Source: US DOT Pipeline & Hazardous Materials Safety Administration http://primis.phmsa.dot.gov/comm/reports/safety/WA_detail1.html	

Previous Occurrences [63], [64], [65]

Two state agencies have jurisdiction over pipelines. The Washington State Utilities and Transportation Commission (UTC) is the responsible agency for the inspection and regulation of pipelines in Washington. The Commission's pipeline safety program began inspecting natural gas systems operating in Washington in 1955. Intrastate hazardous liquid pipelines were added to the Commission's responsibilities in 1996. In 2000, the Washington State Legislature approved the *Pipeline Safety Act (HB2420)*, which directed the Commission's pipeline safety program to seek federal approval to include inspections of all interstate pipelines. In 2001, the State Legislature adopted the *Pipeline Safety Funding*

Bill (SB 5182). In addition, in 2003, the Washington UTC became the lead inspector for all interstate pipeline inspections and incidents. The State Pipeline Inspection Program is supported through a combination of federal grants and pipeline fees. The Washington Department of Ecology is the head of the state incident command system in response to a spill of oil or hazardous substances. Ecology coordinates the response efforts of all state agencies and local emergency response personnel. Petroleum pipeline companies are required to provide Ecology with contingency plans that describe their response to oil spills should they occur. Drills are routinely conducted to test the plans.

U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) defines Significant Pipeline Incident as those incidents reported by pipeline operators when any of the following specifically defined consequences occur: 1) fatality or injury requiring in-patient hospitalization; 2) $50,000 or more in total costs, measured in 1984 dollars; 3) highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more; 4) liquid releases resulting in an unintentional fire or explosion.

Table 10 Washington All Pipeline Systems: 2002-2011

Year	Number	Fatalities	Injuries	Property Damage	Gross Barrels Spilled (Haz Liq)	Net Barrels Lost (Haz Liq)
2002	4	0	0	$281,541	49	13
2003	5	0	0	$607,827	3	3
2004	8	1	2	$1,430,008	45	25
2005	3	0	0	$61,526	1	0
2006	2	0	0	$226,260	0	0
2007	1	0	0	$38,002	0	0
2008	4	0	1	$800,596	85	71
2009	6	0	2	$933,615	1	0
2010	3	0	0	$310,530	0	0
2011	6	0	3	$790,201	0	0
Totals	42	1	8	$5,480,109	187	112
2012 YTD	3	0	0	$170,500	3	0

Source: US DOT Pipeline & Hazardous Materials Safety Administration
http://primis.phmsa.dot.gov/comm/reports/safety/WA_detail1.html

Only a few notable pipeline incidents occurred in Washington in the past 15 years. Most spills from liquid petroleum pipelines have been no larger than a few gallons. The three exceptions are from Olympic Pipe Line. On December 28, 2002 a spill of 1,465 gallons of trans-mix occurred at the Renton Control Center. This spill was caused by equipment failure and went into a containment vault. No oil was released into the environment. On May 23, 2004 a breach in a 3/8 inch sampler line caused a release of 1,890 gallons of gasoline, also at the Renton Control Center. The gasoline subsequently caught fire and burned the sampling shed. Some of the gasoline was released to the environment. The largest release in Washington in recent years was from Olympic Pipeline when the pipeline ruptured, caught fire, and exploded at Whatcom Fall Park in the city of Bellingham on June 10, 1999. The ruptured line leaked 277,000 gallons of gasoline into a creek bed and resulted in three casualties.

On February 8, 1997, a natural gas pipeline caught fire and exploded near Everson. The explosion occurred in a remote area of mostly wooded and mountainous terrain, which was a former glacier slide area. The 26-inch pipeline involved in the explosion failed due to ground movement of water-saturated soil. The following day, February 9, 1997, a natural gas pipeline caught fire and exploded near Kalama. This explosion also occurred in a remote area and was the result of ground movement that caused a break at a weld within the pipeline resulting in the explosion.

Pipeline incidents often occur due to problems such as corrosion. Corrosion is the deterioration of metal that results from a reaction with the environment which changes the iron contained in pipe to iron oxide (rust). Corrosion can occur on the external and internal portions of the pipe and can result in the gradual reduction of the wall thickness and a resulting loss of pipe strength. This loss of pipe strength could then result in leakage or rupture of the pipeline due to internal pressure stresses unless the corrosion is repaired, the affected pipeline section is replaced, or the operating pressure of the pipeline is reduced. Pipeline corrosion creates weakness at points in the pipe, which in turn makes the pipe more susceptible to other risks such as third party damage, overpressure events, natural disasters, etc.

Events such as flooding and earthquakes can increase the likelihood of a pipeline incident. The Northridge Earthquake occurred on January 17, 1994 and damaged buildings, highways, and other structures in Southern California. In addition to building and highway damage, this earthquake damaged several crude oil underground pipelines in the area. One of these pipelines ruptured and spilled 177,000 gallons of crude oil into a storm drainage system, which flowed into the Santa Clara River. The crude oil flowed down the river for about 16 miles causing extensive environmental damage.

Heavy rains and catastrophic flooding of the San Jacinto River near Houston, Texas caused eight oil pipelines to rupture and burn on October 19-20, 1994 (Figure 2). The surging floodwaters of the river washed away soil over and under the pipelines involved in the incident, exposing them to intense hydraulic pressures that bent and twisted them until they eventually burst. These pipeline ruptures, spilled an estimated 2.5 million gallons of crude oil, refined petroleum products, and liquefied petroleum gas into the river and Galveston Bay. The fires resulting from this incident caused extensive damage to many structures that were thus unaffected by the flooding and injured an estimated 1,830 people.

Figure 32 San Jacinto River Flooding and Pipeline Explosion, October 19-20, 1994

Although only affecting the immediate area in which these incidents occur, these spills illustrate the vulnerability of pipelines in earthquake-prone and flood prone areas. Pipeline vulnerabilities to both earthquakes and flooding should be considered when designing and building new pipelines due to the history of these events in Washington.

Probability of Future Events

There are thirty pipeline companies in Washington with the responsibility for the operation of 24,000 miles of pipelines. Over 22,000 miles of pipeline provide natural gas to residential neighborhoods and over 700 miles of pipelines carry gasoline, diesel, jet fuel, crude oil, and butane. Twenty-one of the thirty pipelines carry natural or hydrogen gas and ten of these carry hazardous liquids such as crude oil, gasoline, and jet fuel. There are nine interstate pipelines in Washington – five carry liquids and three carry natural gas. Interstate pipelines typically are large diameter pipelines that operate at very high pressures.

The transportation of hazardous liquids and gases is safer by pipelines then by any other means (Figure 3). However, if an incident occurs at a pipeline the results could be disastrous. With the continued expansion of the population in the State, especially the Puget Sound region, many people now live closer to pipelines then were originally planned. Many of these pipelines are within a few blocks of schools and in one case in Pierce County, actually run under a school playground. A major break in a pipeline at one of these locations could not only shut down major transportation routes for a short period of time to deal with the response but could affect a large portion of the community in which the event occurs.

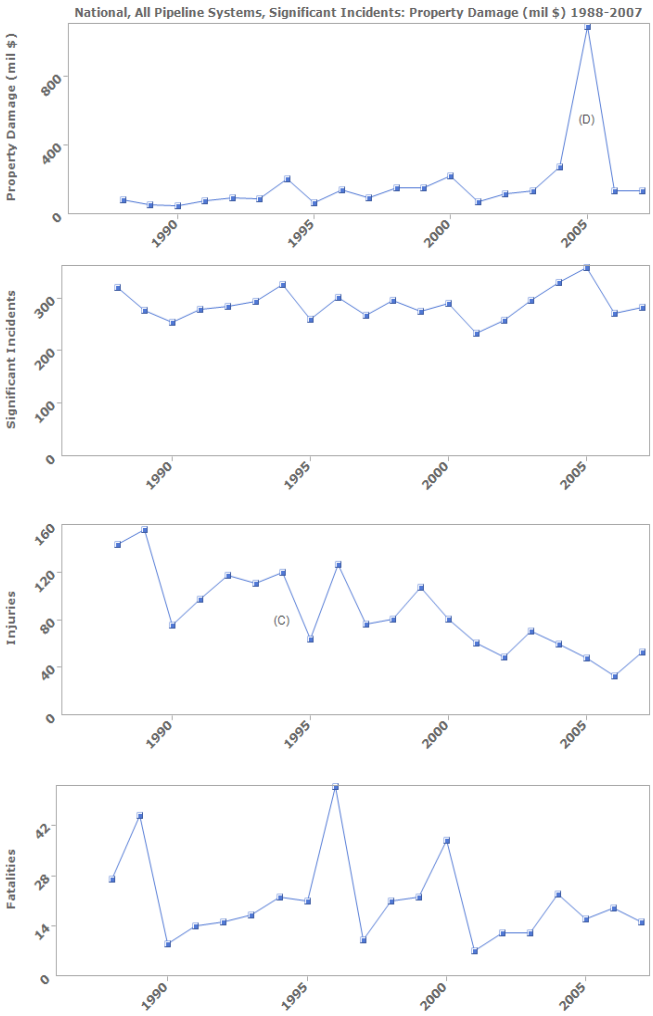


Figure 33 U.S. Pipeline Significant Incidents from 1988-2007

Pipeline incidents are the results of a rupture or break in a pipeline that causes a spill and sometimes a fire or explosion. The hazardous liquids spilled from the pipeline can damage streams, rivers, and other sensitive areas. Ignition of the hazardous liquids from the pipeline can damage sensitive areas, habitat, and residential and commercial property.

Populations near pipelines are potentially vulnerable to an incident. Pipelines near rivers or streams with a history of flooding are vulnerable to an incident. Pipelines on or near earthquake faults or landslide areas are vulnerable to an incident. Pipelines near and around excavation work are vulnerable to an incident.

The best way to reduce the number of pipeline incidents occurring in Washington is to have pipeline companies fully comply with the safety measures set forth in the Washington State Pipeline Safety Act and for the Washington Utilities and Transportation Commission (UTC) to make regular inspections of

pipelines. After a third party, earthquake or flood incident, the pipeline company should provide an immediate inspection, spill prevention, and cleanup of damaged sections of the pipeline. The Washington Department of Ecology should oversee incident response for larger ruptures or breaks.

Possible broad mitigation strategies for reducing the vulnerability and risks associated with pipelines include: pipeline integrity management assessments; enhancing public education and awareness on the hazards of pipelines and their location near communities and populated centers; improving communication and information sharing between pipeline companies and local government agencies, particularly those involved with land-use planning and emergency management and response; and enhancing pipeline company support and cooperation with local emergency first responders.

Washington UTC Pipeline Safety Program participated in land use research to integrate mitigation land use planning efforts. The presence of a pipeline forms a relationship between pipeline operator, local government, and property owner. How this relationship is managed can affect directly the safe operation of the pipeline and consequently the public health and safety of the surrounding community. In 2004 and 2005, a group of city, county, state, and industry representatives conducted a series of workshops throughout the state for local government officials, talking in particular with planning, permitting, and public works sections. The purpose of these workshops was to exchange ideas and explore the range of tools available to manage and make effective decisions concerning land use in proximity to transmission pipelines. This report titled *Land Use Planning In Proximity to Natural Gas and Hazardous Liquid Transmission Pipelines in Washington State, June 2006*[66] is the product of that research.

Jurisdictions most Threatened and Vulnerable to Pipeline Hazards[67]

Most of the over 3,200 miles of transmission pipelines in Washington were constructed in farmland bypassing urban areas. However, to accommodate population and economic growth, land areas once considered rural are being absorbed into expanding urban growth areas and developed to urban uses.

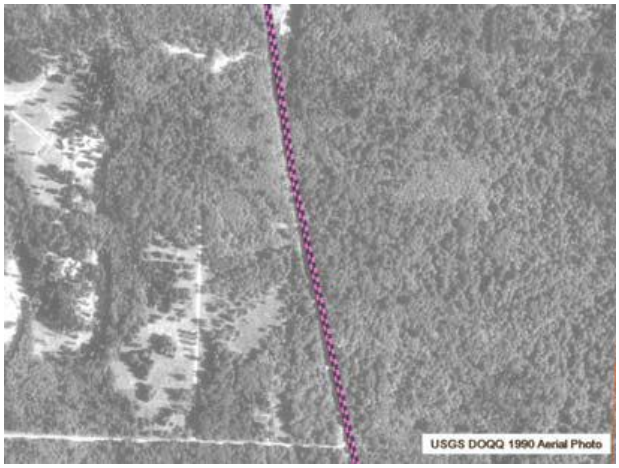


Figure 34 - 1990

Figure 35 - 2002

Nine of the state's 10 fastest growing counties in 2005 are home to almost half of the state's major pipeline mileage. This growth means more and more people are working and living near major pipelines. Increases in population and land use activity expand the risks of pipeline damage and raise the stakes in the event of a pipeline incident. The pictures above were taken of the same area in Washington State – 12 years apart

Pipeline safety and environmental regulations have generally focused on the design, operation, and maintenance of pipelines and incident response. They have not directed significant attention to the manner in which land use decisions in proximity to pipelines can affect public health and safety. Building codes and development regulations for critical areas, seismic resiliency, fire prevention, etc work. Now this methodology is being applied to pipelines.

Potential Climate Change Impacts [68, 69, 70, 71]

With the advent of climate change coming into worldwide focus; it is necessary to take into account the potential effects this emerging climate crisis may have on the dangers associated with pipeline failures. The research done so far indicates the potential for unusual or more frequent heavy rainfall and flooding is greater is some areas while the potential for drought is predicted in other areas. Landslide frequency is correlated with heavy rainfall and flooding events.

According to a 2005 Governor's report prepared by the Climate Impacts Group titled *Uncertain Future: Climate Change and its Effects on Puget Sound*, from "paleoclimatological evidence, we know that over the history of the earth high levels of greenhouse gas concentrations have correlated with, and to a large extent caused, significant warming to occur, with impacts generated on a global scale." While the report also indicates that the "ultimate impact of climate change on any individual species or ecosystem cannot be predicted with precision," there is no doubt that Washington's climate has demonstrated change.

In July 2007, the Climate Impacts Group launched an unprecedented assessment of climate change impacts on Washington State. *The Washington Climate Change Impacts Assessment* (WACCIA) involved

developing updated climate change scenarios for Washington State and using these scenarios to assess the impacts of climate change on the following sectors: agriculture, coasts, energy, forests, human health, hydrology and water resources, salmon, and urban stormwater infrastructure. The assessment was funded by the Washington State Legislature through House Bill 1303.

In 2009, the Washington State Legislature approved the *State Agency Climate Leadership Act* Senate Bill 5560. The Act committed state agencies to lead by example in reducing their greenhouse gas (GHG) emissions to: 15 percent below 2005 levels by 2020; 36 percent below 2005 by 2035; and 57.5 percent below 2005 levels (or 70 percent below the expected state government emissions that year, whichever amount is greater.). The Act, codified in RCW 70.235.050-070, directed agencies to annually measure their greenhouse gas emissions, estimate future emissions, track actions taken to reduce emissions, and develop a strategy to meet the reduction targets. Starting in 2012 and every two years thereafter, each state agency is required to report to Washington State Department of Ecology the actions taken to meet the emission reduction targets under the strategy for the preceding biennium.

Recognizing Washington's vulnerability to climate impacts, the Legislature and Governor Chris Gregoire directed state agencies to develop an integrated climate change response strategy to help state, tribal, and local governments, public and private organizations, businesses, and individuals prepare. The state Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Health, Natural Resources and Transportation worked with a broad range of interested parties to develop recommendations that form the basis for a report by the Department of Ecology: *Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy*.

Over the next 50 - 100 years, the potential exists for significant climate change impacts on Washington's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts could potentially include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Therefore, climate change has the potential to impact the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses. Recognizing the global, regional, and local implications of climate change, Washington State has shown great leadership in addressing mitigation through the reduction of greenhouse gases.

At Risk State Facilities [72]

Was not determined or mapped at the time of writing.

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Public Health Communicable Disease Outbreaks, Epidemics, Pandemics

 Epidemic	**Frequency**	50+ yrs	10-50 yrs	1-10 yrs	Annually
	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
	Hazard scale			< Low to High >	

Risk Level

Frequency – Communicable Disease outbreaks occur annually in Washington. An epidemic or pandemic happens two or three times a century.
People –There is the potential for significant hospitalizations and loss of life from outbreaks of communicable diseases. According to the pandemic modeling software, FluAid, developed by the U.S. Center for Disease Control, over 1 million people in Washington State may become ill if a severe pandemic, such as the 1918 pandemic event occurred.
Economy – Except for a widespread influenza outbreak, an incident is unlikely to cause the loss of 1% of the State GDP. Nonetheless, during an epidemic/pandemic, businesses that provide goods and services will temporarily close thereby adversely affecting the economy of our state.
Environment – An incident is unlikely to cause the loss of 10% of a single species or habitat.
Property – An incident is unlikely to cause $100 million in property damage.

HIVA Risk Classification for Epidemic / Pandemic is 2C or Mitigation to Reduce Risk is Required.

Summary

The Hazard: Communicable disease outbreaks can be caused by many agents. Public health measures have controlled many diseases in this country. There remains a risk from new agents that emerge with the potential to cause outbreaks, such as new types of influenza or SARS.

Previous Occurrences: Washington has experience with some communicable disease outbreaks, such as influenza, pertussis, and foodborne outbreaks. International outbreaks include influenza, SARS, and cholera.

Probability of Future Events: Periodic outbreaks including influenza are likely in Washington. The state's connection to the global economy increases the risk of a new disease being introduced. The potential for natural disasters such as floods, earthquakes, or volcanic eruptions could result in displaced populations and mass sheltering, with the potential for communicable disease outbreaks.

Jurisdictions at Greatest Risk: All jurisdictions are at risk for outbreaks due to contaminated food or spread of respiratory infections such as pertussis or influenza. The risk of outbreaks depends on factors such as population density, contact with animals, international travel and commerce, and access to health care.

Special Note: This profile will not attempt to estimate potential losses to state facilities due to communicable disease outbreak. This hazard poses little threat to the built environment.

The Hazard [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94]

Communicable disease outbreaks are defined by the Centers for Disease Control and Prevention (CDC) as the occurrence of more cases of disease than normally expected within a specific place or group of people over a given period of time. Outbreaks may occur on a periodic basis (e.g., influenza), may occur rarely but result in severe disease (e.g., meningococcal meningitis), may occur after a disaster (e.g., cholera), or may represent an intentional release of an agent (e.g., bioterrorism). An epidemic is a disease occurring suddenly in humans in a community, region, or country in numbers in excess of normal while a pandemic is the worldwide outbreak of a disease in humans in numbers clearly in excess of normal.

Agents causing outbreaks can be viruses, bacteria, parasites, fungi, or toxins. An individual may be exposed by breathing, eating or drinking, or having direct contact with an agent. These agents can be spread by people, contaminated food or water, animals, insects and other arthropods, or directly from the environment. Some agents, such as *Salmonella* or *E. coli* O157:H7 may have multiple means of spreading. Other agents, such as measles or pertussis, are spread only from one person to another.

In the United States, better hygiene and water quality improved the health of the general population during the first half of the 20th century. The availability of medical care and vaccines further reduced communicable diseases. After World War II, the availability of antibiotics enabled health care providers to treat many bacterial diseases. The development of vaccines assisted in the control of other diseases such as chickenpox, mumps, polio, and measles. However, infectious diseases did not vanish as was hoped, but persisted while new strains of pathogens emerged. Antibiotic resistance has emerged and new infectious diseases have been identified.

New agents are continually emerging to cause outbreaks in populations where nobody has immunity. In 1957 and 1968, new strains of influenza (flu) spread rapidly around the world. Although less severe than the 1918 flu strain which caused a global pandemic, these strains still resulted in many deaths. During the 1980s, human immunodeficiency virus (HIV) – the cause of acquired immune deficiency syndrome or AIDS – appeared. In the same years, tuberculosis (including strains harder to treat with antibiotics) increased in cities throughout United States. The 2009 outbreak of variant influenza H1N1 affected the entire globe with associated increased mortality.

There are many causes behind the spread of these diseases, including personal choices such as lack of vaccination, poor hand hygiene, risky sexual practices, and shared needles by drug users. In addition, sick people who travel from country to country can be a source of infection, as occurred in the SARS (Severe Acute Respiratory Syndrome) outbreak in Asia and Canada in 2003. Another reason for disease outbreaks include normal evolution of bacteria and viruses, as well as antibiotic resistance that may occur in response to antibiotic usage. Other factors contributing to the spread of disease include economic growth and land use, global trade and climate and weather changes such as global warming. Development of land in areas previously unpopulated by humans can bring humans and animals into closer proximity. Imported foods such as cantaloupe, mangos, and seeds for alfalfa sprouts have been linked to Salmonella outbreaks. Exotic or imported pets are another risk factor for emerging infections such as salmonellosis or monkey pox. Warmer-than-usual water and air can cause more bacterial growth in ocean waters which contaminate shellfish and can lead to an infectious outbreak. Climate changes allow mosquitoes to breed at higher elevations than in the past, spreading disease in new areas.

The impacts of an epidemic or pandemic can be severe. Depending on its severity, a human epidemic could result in death or debilitation, and economic hardship from lost work time, loss of productivity and these effects may cause more widespread harm to the economy. In addition, a serious epidemic or pandemic would likely cause a strain on current public health and medical resources statewide.

The Washington Administrative Code (WAC) requires reporting of notifiable conditions by health care providers, laboratories, and health care facilities, as well as veterinarians, schools, child day care facilities, and food service establishments. Individual cases of certain conditions must be reported to the responsible local health jurisdiction for prompt public health actions to prevent outbreaks. Conditions with outbreak potential include measles, meningococcal meningitis, and severe diarrheal diseases. The WAC also requires reporting of all outbreaks or suspected outbreaks of notifiable conditions, and foodborne or waterborne diseases. Outbreaks or suspected outbreaks related to health care is also reported but not required (e.g., black fungus in steroid injections). The local health jurisdiction takes specific actions to identify the source of the agent and to control its spread.

Most communicable disease outbreaks occur when an agent spreads easily among people, such as respiratory spread of influenza or pertussis. Outbreaks occur where many people are exposed at once, as with foodborne exposures or outbreaks of vomiting and diarrhea due to viruses in schools, childcare centers, and long-term care facilities. Outbreaks can occur due to lack of immunity in a population if there is a new agent or due to low immunization rates for known agents, decreased sanitation, increased crowding, or other factors that promotes spread of an agent.

Although public health agencies have experience with many types of communicable disease outbreaks, a larger public health challenge is emerging pathogens, which are new agents causing disease in humans. An emerging agent may be entirely new, newly recognized, new to an area, or expanding its effect. An agent may emerge for any of a number of reasons:

- Changes in the agent, such as resistance to antibiotics (e.g., MRSA or methicillin resistant *Staphylococcus aureus*)
- Altered climate or ecosystems due to economic growth, agriculture, deforestation, dams, and irrigation (e.g., spread of mosquitoes due to irrigation and climate change, exposure to Ebola during forest clearing)
- International travel and commerce (e.g., SARS, West Nile virus)
- Technology and industry such as a globalized food supply or use of antibiotics on farms (e.g., salmonellosis from imported produce)
- Breakdown of public health infrastructure (e.g., increase in tuberculosis)
- Poverty and social inequalities (e.g., reduced access to vaccines)
- Human behavior and demographics (e.g., reduced vaccinations, childcare center outbreaks)
- Human susceptibility to infection (e.g., infections with immunosuppression)

Certain agents have particular potential for causing severe communicable disease outbreaks

Influenza (flu) is a common respiratory infection that spreads among people and can cause serious illness and death. Frequent small genetic changes in the influenza virus necessitate new vaccines because people lack immunity. A large genetic change in influenza could result in a worldwide pandemic before an effective vaccine could be developed. It is forecasted that Washington State could have 5,000 fatalities, 10,000-24,000 patients needing hospitalization, and 480,000-1,119,000 outpatient

visits from an influenza pandemic. Antiviral treatment can reduce disease severity. It could take months to develop an entirely new vaccine.

Severe Acute Respiratory Syndrome (SARS) is a respiratory illness caused by a virus called SARS-associated corona virus (SARS-CoV) that spreads among people. In 2003 travelers carried SARS from Asia to more than two dozen countries in North America, South America, Europe, and Asia. A total of 8,098 cases occurred and 774 people died. Only eight people in the United States had laboratory evidence of SARS infection, all following travel to countries with SARS; Washington State had no cases. There is no treatment and no vaccine for SARS.

AIDS results when infection with the human immunodeficiency virus (HIV) causes severe immune system dysfunction called acquired immune deficiency syndrome (AIDS). The virus is transmitted from person to person by sexual contact and blood exposure. Antiviral treatments have greatly improved survival of HIV infection. At least 11,000 people live with HIV/AIDS in Washington State with two thirds of them in King County.

Tuberculosis (TB) is bacterial infection primarily of the lungs that is transmitted from person to person. From the early 1940s until the mid-1980s, tuberculosis cases steadily decreased in Washington State to a low of 207 cases, paralleling the national trend. Cases increased from 1984 until 1991 to a high of 309 cases due to immigration from areas of endemic tuberculosis, erosion of the public health infrastructure for ensuring treatment, and to a lesser extent an increase in susceptible people due to HIV infections. In other area some tuberculosis strains are highly resistant to treatment. Isolation, treatment of patients, and testing of contacts is needed to control tuberculosis. Washington State reported 200 cases of TB for a case rate of 3.0 per 100,000 persons in 2011. Only 7 of the 39 counties had 5 or more cases of TB, accounting for 92% of cases in Washington. King County accounted for 106 cases (53%) of the 200 cases (rate 5.5 per 100,000). About 75% of cases in Washington are among foreign-born persons from countries with high rates of TB. Each year there are approximately 250 cases of TB reported in Washington State in recent years, with the number of deaths ranging from 2 to 18. There continues to be a decrease in crude TB incidence rate.

Mosquito-borne diseases include West Nile virus, dengue, and malaria. West Nile virus causes rare severe illness involving meningitis, paralysis, and coma. West Nile virus first appeared in the United States in New York City during 1999 and spread rapidly throughout the country. In Washington State, the first cases of West Nile virus were reported in 2006. Dengue infection has been reported in Washington State only as a travel-associated disease, but infected mosquitoes have become established in Florida in recent years. Malaria could also be introduced into Washington State because the vector mosquitoes are already present in many areas.

E. coli are bacteria that normally live in the intestines of humans and animals, particularly cattle. Although most *E. coli* strains are harmless, strains producing shiga toxin (STEC) can cause severe diarrhea and kidney damage. STEC can be spread by contaminated food (beef, produce) or water or among people if infected persons do not wash their hands after using the toilet or diapering children. Other bacterial agents that can cause severe diarrhea and occur in Washington State include *Salmonella, Shigella,* and typhoid.

Certain agents have particular potential for causing less than severe communicable disease outbreaks

Methicillin-Resistant Staphylococcus Aureus or MRSA is an infection caused by Staphylococcus aureus bacteria — often called "staph." That is resistant to the broad-spectrum antibiotics commonly used to treat it. MRSA can be fatal. The Mayo Clinic states that most MRSA infections occur in hospitals or other health care settings, such as nursing homes and dialysis centers, where it can attack those most vulnerable — older adults and people with weakened immune systems, burns, surgical wounds or serious underlying health problems. This is particularly true for hospital stays of more than 14 days.

Measles is a highly communicable viral rash illness that was a major childhood disease in the pre-vaccine era. Although the disease is now considered rare in Washington and the United States due to routine childhood immunization, sporadic cases of measles and outbreaks continue to occur.

Hepatitis – Hepatitis A, B, and C are viral infections that cause inflammation of the liver. Hepatitis A is usually transmitted by eating food prepared by or close contact with someone who is infected. It is usually a self limited illness and infected persons recover fully and are immune. Hepatitis B and C are primarily transmitted through blood exposures. Hepatitis A and B can be prevented by vaccination. Infections from acute hepatitis A, hepatitis B, and hepatitis C have decreased considerably over the past 15 years. Rates of new infections of hepatitis A and hepatitis B have dropped primarily because people can be immunized against those diseases.

Lyme Disease is caused by Borrelia burgdorferii and is transmitted to humans by tick bites. The first reported case in Washington was in 1987. DOH has received 7 to 18 reports of Lyme disease per year in recent years. Although little is known about the epidemiology of Lyme disease in Washington State, the risk of infection appears to be highest in counties around and west of the Cascade Mountains, reflecting the distribution of the local *Ixodes pacificus* tick vector. Lyme disease is the most commonly reported vector-borne disease in the United States with approximately 20,000 cases reported annually. Lyme disease has a wide distribution in northern temperate regions of the world. In the United States, the reported incidence is highest in the Northeast (particularly in southern New England); the upper Midwest; and in northern California.

Hantavirus Pulmonary Syndrome (HPS) causes a rapidly progressive and severe pneumonia that is often fatal. Since the disease's recognition in 1993 through 2011, there have been 43 reported cases of HPS in Washington State with 13 (30%) associated deaths. Between 1 and 5 cases occur annually in the state.

Leptospirosis is a bacterial infectious disease occurring in both human beings and domestic animals, affecting the kidneys and liver. It may be among the world's most common diseases spread from animals to humans. Leptospirosis is rare in Washington State, with 0 to five cases reported each year. No cases were reported from 1987 through 1995. Of leptospirosis cases reported between 1996 and 2004, only four cases (44 %) reported exposure in Washington State.

Previous Occurrences [95,96,97,98,99,100,101]

Several characteristics of pandemic or epidemic differentiate these episodes from other public health emergencies. First, an epidemic or pandemic has the potential to infect large numbers of Washington State citizens and visitors, which could easily overwhelm the health care system in the state. A pandemic outbreak could also jeopardize essential community services by causing high levels of absenteeism in critical positions in every workforce. It is likely that vaccines against a new virus will not be available for six to eight months following the arrival of the virus in the United States. Basic public services such as health care, law enforcement, fire and emergency response, communications,

transportation, and utilities could all be disrupted or severally lessened. Finally, the pandemic, unlike other public health emergencies, could last for several weeks or months. Pandemic influenza will affect many regions simultaneously and therefore outside resources may be unavailable.

Influenza occurs regularly in Washington State. When looking at the death tolls for previous flu pandemics, the number of deaths experienced was influenced by the population of the areas that it was introduced. In 1918, the largest concentrations of people in Washington lived in urban areas such as Seattle (1918 population 315,312), Tacoma (1918 population 96,965) and Spokane (1918 population 104, 437) with an overall state population of 1.35 million. Death tolls for the 1918 influenza pandemic were much higher in these three cities then in other cities in the state (Figure 6-2), likely due to the large population of people living there. The population of the area in which the agent is introduced will largely influence the quantity of people affected by an epidemic or pandemic. The greatest populations in Washington State exist in King, Pierce, and Snohomish counties. These counties should consider their large populations when planning and preparing for the next epidemic or pandemic.

Pandemics of influenza have occurred throughout recorded history and have been documented since the 16th century. Since the well-documented pandemic of influenza-like disease occurred in 1520 there have been 31 influenza pandemics documented. Intervals between previous pandemics have varied from 11 to 42 years with no recognizable pattern. Three pandemics occurred in the last century. The most recent was in 1968/69, with prior pandemics occurring in 1957/58 and 1918/19 (Figure 6-3).

Pandemics Death Toll Since 1900	
1918-1919	
U.S....	675,000+
Worldwide...	50,000,000+
This as per the CDC.	
1957-1958	
U.S....	70,000+
Worldwide...	1-2,000,000
1968-1969	
U.S....	34,000+
Worldwide...	700,000+

Figure 36 Pandemic Influenza Death Toll since

The 1918/19 Influenza Pandemic "is the catastrophe against which all modern pandemics are measured. Before the 1918/19 pandemic, one has to go back to the "black death" (bubonic plague) of 1346 to find a similarly devastating epidemic in terms of total number of deaths". It is estimated that approximately 20 to 40 percent of the worldwide population became ill during the 1918/19 influenza pandemic. The number of worldwide deaths due to the pandemic was initially reported as 20 million, but consensus among experts now believe the death toll was at least 40 million with some believing it could have been as high as 50 to 100 million deaths. Between September 1918 and April 1919, approximately 500,000 to 650,000 deaths from the pandemic flu occurred in the United States alone. Western Samoa and Iceland were the only countries to avoid the 1918 flu entirely due to the use of strict travel restrictions during the pandemic.

The 1957/58 Influenza Pandemic was on the whole much milder than that of the 1918 influenza, with the global death toll reaching 2 million. The 1968 Hong Kong Flu outbreak resulted in nearly 34,000 deaths in the United States. The 1968/69 influenza pandemic is thought to have caused around 1 million deaths worldwide. Due to advances in science from the 1918/19 influenza, worldwide vaccine production began shortly after the pandemic of 1957/58 and 1968/69, likely lessening the death rates for both of these events.

The 2009/2010 novel influenza A (H1N1) is a new flu virus of swine origin that first caused illness in Mexico and the United States in March and April, 2009. The first novel H1N1 patient in the United States was confirmed by laboratory testing at CDC on April 15, 2009. The second patient was confirmed

on April 17, 2009. It was quickly determined that the virus was spreading from person-to-person. On April 22, the Centers for Disease Control and Prevention (CDC) activated its Emergency Operations Center to better coordinate the public health response. On April 26, 2009, the United States Government declared a public health emergency and implemented the nation's pandemic response plan. By June 3, 2009, all 50 states in the United States and the District of Columbia and Puerto Rico were reporting cases of novel H1N1 infection. The nationwide U.S. influenza surveillance systems report 41,821 hospitalizations and 2,117 deaths from H1N1 through April 16, 2010. The Washington State Department of Health reported 1,516 hospitalizations and 99 fatalities from laboratory confirmed influenza H1N1 cases.

Food-borne outbreaks occur every year in Washington State. Bacteria, viruses, and toxins are responsible for most outbreaks. Although restaurant and commercial exposures are most commonly reported as the cause of outbreaks, it is likely that many more small clusters of illness occur due to mishandled food in the home setting. The largest Washington State *E. coli* O157:H7 outbreak was in 1993, when 477 people were infected from contaminated, undercooked hamburger. In 1994, 11 people were infected from contaminated ground beef and also in 1994, 15 people were infected from contaminated salami. Additional outbreaks have occurred in the United States from non-beef sources including lettuce and salad bars where foods were contaminated by improperly cleaned utensils, working surfaces and infected food handlers. Also, outbreaks have occurred in people who have consumed garden vegetables fertilized with animal manure, unpasteurized apple cider, and homemade venison jerky. Recently there have been cases due to contaminated swimming water and petting farms. Most Shiga toxin-producing *E. coli (*STEC) infections are single cases and not associated with outbreaks. Annually there are 150-300 reported cases in Washington State.

Washington Foodborne Disease Outbreaks 1991-2010 (Source: Washington State Communicable Disease Report 2010)

Year	Cases	Outbreaks
1991	1154	47
1992	740	53
1993	1301	130
1994	1462	151
1995	909	138
1996	685	124
1997	810	108
1998	706	60
1999	1164	93
2000	938	66
2001	574	69
2002	704	56
2003	620	55
2004	679	58
2005	390	42
2006	677	51
2007	722	43
2008	564	46
2009	307	27
2010	344	37

Table 11 Foodborne Disease Outbreaks

Pertussis (Whooping Cough) has affected most Washington counties in 2012 with over 2500 cases reported during the first six months of the year, more than double the total of the previous year. The number of cases reported each year varies considerably, ranging from 184 to 1026 cases a year since 1995. There is also a variation in the rate of reported disease among health jurisdictions, reflecting local outbreaks.

West Nile Virus was first identified in the US in 1999. It can affect people, horses, certain types of birds, and other animals. The Washington State Department of Health reports four human cases in 2012. The reported cases peaked in 2009 with 34 reported cases in human. Ongoing West Nile virus monitoring for infected dead birds and mosquitoes is limited to a few counties due to a lack of resources.

Probability of Future Events

There are expected periodic outbreaks of certain communicable diseases. Each winter there is an influenza season, with 10-20% of the state population affected. Washington had 30-50 foodborne outbreaks reported each year. Other outbreaks such as pertussis or hepatitis A may occur every few years while measles outbreaks are rare.

Through Washington's numerous connections to the global economy there is elevated potential for disease introduction due to several factors: the large number of passengers arriving daily at air or sea ports and the intentional or inadvertent importation of infected animals.

Following a disaster such as an earthquake, volcanic eruption, or tsunami, communicable disease outbreaks could result from lack of safe water and food, disruption of waste treatment, and mass sheltering of people. However, the existing public health structure has minimize the presence of potential agents such as measles, typhoid, or hepatitis in the population so large outbreaks are less likely in this country than elsewhere on the globe. Mass sheltering is more likely to result in outbreaks of mild to moderate respiratory infections, viral gastroenteritis, and skin infections.

Determining the probability of future public health events is difficult. There are many factors which influence the probability of future outbreaks of disease and include ill travelers coming in to our region, and increased proximity between animals and people. Another contributing factor includes Washington's role in the global economy. Because of this, the State's potential risk is elevated by

several factors: the large number of passengers arriving on daily basis at any of our air or sea ports; infected animals coming into our region through shipping containers that may not be known to be on board the vessels; animals being imported for sale (both as pets and as a food source); or the illegal sale of banned or dangerous animals. Likewise, another potential disease source includes infected animals traveling across the border from neighboring states or British Columbia. Avian diseases could be brought in by birds on their annual migration from Alaska and Canada, or from areas as far south as Mexico or South America. Even travelers to foreign countries who visit agricultural areas may unknowingly transport animal diseases to this country. Contaminated garbage tossed overboard from a ship off the coast has also been identified as a potential source of disease when it washes on shore and is eaten by animals. The transporting of patients from one hospital to another can be a vector for disease transmission, as can visiting someone who is ill in a hospital or nursing home.

Influenza and Pneumonia Deaths in 1918 By Age

Age (yrs)	# Deaths
< 1	333
1	132
2	66
3	54
4	44
5-9	129
10-19	491
20-29	1243
30-39	1218
40-49	435
50-59	257
60-69	190
70-79	165
80-89	87
90-99	12

Figure 37 1918 Influenza Pandemic Deaths in Washington by Age

A pandemic influenza outbreak could kill hundreds of thousands of Americans and possibly more than 40,000 Washington citizens. Unlike the ordinary flu, people of any age and health condition can become seriously ill and no one will have immunity to a pandemic flu virus. With a pandemic influenza, no one is immune to this virus and the normally considered vulnerable populations that include the elderly and young children may not be the only portions of the population most vulnerable to a pandemic influenza. In fact, the 1918 pandemic had a gross disproportion of 20 to 40 year olds die in the pandemic, a portion of the population not thought to be the most vulnerable to diseases. This was later found to be contributed to a large portion of this section of the population being carriers of tuberculosis, which weakened their immune system, but no one knows what contributing factors may have an effect on susceptibility to the next pandemic.

Previously, there were no early warning systems in place for the past three pandemics. To reduce the risks of the next pandemic, each country needs to have a communications strategy to educate the public about pandemic flu. Human-to-human transmission needs detected at the earliest to lessen and combat the effects of the next pandemic.

The U.S. Department of Health and Human Services', Centers for Disease Control and Prevention (CDC), Division of Strategic National Stockpile (SNS) staff operates the nation's repository of medical resources, equipment, and services for augmenting within 12-hours State and local resources in the fight against dangerous diseases, chemicals, or other hazards. The SNS is organized for flexible response and is able to deliver medical materiel quickly by using several different concepts: 12-Hour Push Packages, Managed Inventory, and Rapid Purchasing Power. The state has a formal plan within the CEMP, ESF 8, to request and take delivery of SNS resources and distribute them onto local jurisdictions.

A safe water supply, good hygiene, effective sewage and waste disposal, aggressive monitoring, public education, prevention and treatment of potential disease outbreaks by public health officials are the primary mitigation efforts for potential pandemic/epidemic outbreaks. Actions such as frequent hand

washings, covering one's mouth when they cough, and staying home when ill have an enormous impact on maintaining control of an infectious disease by limiting the spread of germs.

Basic mitigation measures also include: childhood and adult immunization programs; health education in the schools and on a community level to address disease transmission and prevention; targeting the mechanism of transmission, such as drug usage for diseases like HIV infection and Hepatitis B; maintaining strict health standards for food service employees and eating establishments; maintaining strict health standards for food products; and utilizing accepted and recommended infection control practices in medical facilities.

Jurisdictions Most Vulnerable to Communicable Disease Outbreaks

More densely populated areas have a greater risk for the spread of agents among humans, while areas with a higher density of animals may have a higher potential for acquiring diseases from animals. Urban areas are more likely to require mass sheltering following a disaster, with its inherent potential for disease transmission. Rural areas may have more limited options for health care access. The Puget Sound region has international airports which serve large populations of humans and animals from across the planet. Immigrant and poverty stricken populations are more vulnerable to communicable disease outbreaks. Therefore, the whole state remains vulnerable to the various communicable diseases discussed.

Economic Impacts

The impacts of any large outbreak can be severe, and could result in increased deaths, economic hardship from lost work time, and loss of productivity. There would also be a strain on public health and medical resources statewide. In particular, pandemic influenza or other severe respiratory disease causing many cases with a high death rate could result in severe social disruption and major economic impacts. Other communicable disease outbreaks are likely to have only local impact on businesses, industries, transportation systems, or governmental agencies.

Potential Climate Change Impacts [102]

Climate change could increase outbreaks through several mechanisms including expanding the range of animals or arthropods carrying disease agents, increasing the level of certain agents such as Vibrio bacteria in shellfish, or promoting environmental growth of agents such as fungi. An example is changes in rodent populations with climate and food supply resulting in Hantavirus outbreaks.

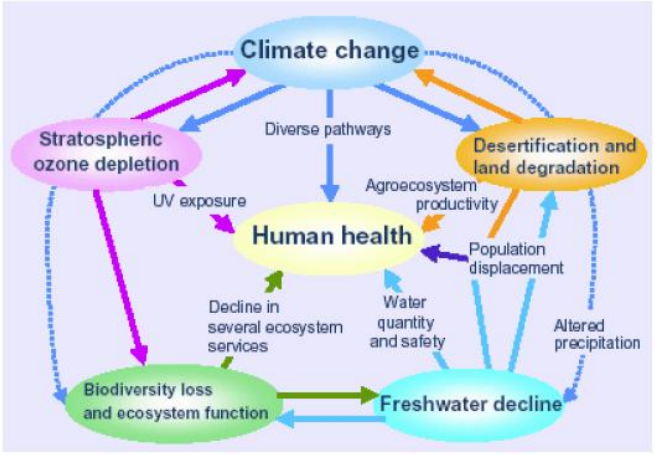

Figure 38 Human Health and the Effects of Climate

The impacts of climate change on human health will not be evenly distributed around the world. Developing country populations, particularly in small island states, arid and high mountain zones, and in densely populated coastal areas, are considered to be particularly vulnerable. Fortunately, most of the health risk associated with climate change can be avoided through existing health programs and interventions. Concerted action to strengthen key features of health systems and to promote healthy development choices can enhance public health now as well as reduce vulnerability to the effects of future climate change. The risk of a

pandemic or epidemic event is not seen as being directly tied to changes in climate in the United States but may play a factor in the spread of such an outbreak in developing countries.

Mitigation Activities

Routine public health interventions at the local level include disease surveillance, immunization program, health education, food safety programs, verifying case treatment (e.g., tuberculosis), excluding ill cases from work or school (e.g., diarrhea), inspecting restaurants (e.g., foodborne outbreak), or recommending vaccination to a community (e.g., pertussis outbreak) can prevent or limit an outbreak. Large scale outbreaks could require additional interventions if there are disrupted water supplies or damaged housing. During a widespread or severe outbreak there are additional areas of potential public health response and mitigation that could include:

- Education of the public, health care providers, and public health system
- Enhanced disease surveillance
- General hygiene measures (food, water, sewage, respiratory hygiene)
- Isolation of cases
- Quarantine of contacts
- Mass distribution of medication for prophylaxis or treatment
- Mass immunization
- Alternate care facilities (acute disease, chronic care)
- Required medical examination
- Seizure of medical equipment
- Provision of food, water, and shelter
- Closure of schools, businesses, entertainment venues, recreational events
- Travel restrictions
- Mass evacuation
- Mass burials of humans
- Dispose of contaminated material
- Decontamination of environment

Special public health response planning would be necessary for large scale community measures such as mass distribution of pharmaceuticals or mass immunization. This could involve national resources like the CDC's Strategic National Stockpile. The SNS is a large national repository (cache) of life-saving pharmaceuticals and medical supplies to protect the American public if there is a public health emergency severe enough to cause local supplies to run out (e.g. terrorist attack, pandemic influenza outbreak, or earthquake).

U.S. Department of Health and Human Services (HHS) will deliver SNS assets to a pre-designated state warehouse. This warehouse is referred to as a receiving, staging, and storing (RSS) site. Once SNS assets arrive at the designated RSS site, HHS will transfer authority for the materiel to state authorities. State and local authorities will then begin the breakdown of the 12-hour Push Package for distribution and dispensing.

12-hour Push Package: The first line of Strategic National Stockpile (SNS) support is the 12-hour Push Package, a cache of pharmaceuticals, antidotes, and medical supplies designed to provide rapid delivery of a broad spectrum of assets for an ill-defined threat in the early hours of an event. The 12-hour Push Packages are positioned in strategically located, secure warehouses ready for immediate deployment to a designated site within 12 hours of the federal decision to deploy SNS assets. The assets are shipped in specially designed Lexan cargo containers to facilitate rapid staging at the state receipt, stage, and store (RSS) facility.

Managed Inventory: DSNS managed inventory (MI) contains medications and medical supplies for specific threats. MI can be shipped if the disease agent is known or as follow-on material to 12-hour Push Packages during an ill-defined threat. MI will take longer to reach project areas (upwards of 24 – 36 hours) but can be tailored to a specific, well-defined threat or disease agent.

Rapid Purchasing Power: CDC is able to provide additional medications and medical supplies through contracts with the Veterans Administration. CDC can use this mechanism during an emergency to rapidly procure additional materials that are not typically part of the SNS formulary.

At Risk State Facilities

This profile will not attempt to estimate potential losses to state facilities due to communicable disease outbreak. This hazard poses little threat to the built environment, but can pose significant risk and damage to the state's economy and citizens, residents and tourists.

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Terrorism

	**Frequency**	50+ yrs	10-50 yrs	1-10 yrs	Annually
	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
Terrorism	**Hazard scale**			< Low to High >	

Risk Level

Frequency – Due to the differing types of terrorism and the variety of terrorist, political, and social extremist groups that perpetuate these acts, the likelihood of any act of terrorism taking place in Washington State is believed to be a frequency of once every 1 to 10 years. ***Note****: Although terrorist or violent extremist attacks and plots have not occurred consistently within the past decade, the Northwest has encountered more than 20 attempted and successful attacks in the past decade; averaging out to two per year.*

People – If a terrorist attack were to occur in a highly populated city in Washington, it can be expected that 1,000 to 10,000 people could potentially be impacted. ***Note****: This is based on a 'worst case' scenario, where an improvised explosive device (IED) is used in a large-scale attack similar to that of 9/11 or Mumbai. A more likely case scenario would be an active shooter, in which less than 100 people would be impacted. The actual numbers of people impacted by a terror event is dependent upon the terrorists' motivation or desired outcome, tactic used, specific location, and weapon type.*

Economy – Recent terrorist attacks in the U.S. have negatively affected the local economy of the cities in which they occurred. If a terrorist attack were to occur in Washington State, a 1-2% gross domestic product (GDP) change would be an expected result. ***Note****: The psychosocial impacts would be a major effecting factor on the economy, in addition to the physical damage caused by a terror attack. Psychosocial impacts, also known as the "fear factor", can include: the populaces' perceptions of local or regional stability, hesitation of going to large public gatherings, mistrust in law enforcement and government to deter terror events, and a general uneasiness in certain areas where an extremist attack has occurred.*

Environment – Although the environment can be affected by an act of terrorism, the potential eradication of more than 10% of a species or habitat is considered to be unlikely. ***Note****: Though assessed to be of low probability, if arson is used as the primary tactic, such as an intentional forest fire, the environmental damages would grow exponentially with the size of the spread.*

Property – If a large-scale attack was to occur in a highly populated city or on a critical infrastructure in Washington State, the expected damage would likely be in excess of $1 billion. ***Note****: This is based on a 'worst case scenario', where an IED is involved. A more likely case scenario would be an active shooter, in which less than $1 million of damages would occur. The actual dollar amount incurred in any terror*

event is completely dependent upon the terrorists' motivation or desired outcome, tactic used, specific location, and weapon type.

HIVA Risk Classification for Terrorism is 1C or Mitigation to Reduce Risk is Required.

Summary

Hazard – Terrorism is a man-made hazard that is defined by the Federal Bureau of Investigation (FBI) as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objective". This threat includes acts of terrorism by international terrorist organizations, independent terror cells, homegrown violent extremists (HVEs), 'lone wolf' violent extremists, and any other group or individual using terror tactics (i.e. violence, death, damage, etc.) in the progression of their goals.

Table 12 Regional Terror and Violent Extremist Cases	
May 2012	Ian Stawicki – Opened fire at Seattle coffee shop, hijacked car, killed himself.
Oct 2011	Abdisalan Hussein Ali – 3rd American killed as Al-Shabaab suicide bomber.
Sep 2011	Michael McCright – Vehicular Assault against U.S. Marines on I-5 in Seattle.
Jun 2011	Abu Khalid Abdul-Latif and Walli Mujahidh – Seattle MEPS attack plot.
May 2011	Joseph Brice – Amateur IED maker advertising via YouTube in Clarkston, WA.
Jan 2011	Kevin Harpham – Foiled Spokane MLK Jr. Parade backpack bomb plot.
Nov 2010	Mohamed Osman Mohamud – Foiled Portland Christmas Tree VBIED Bombing.
Nov 2009	Maurice Clemmons – Murdered 4 Lakewood Police Officers at a coffee shop.
Oct 2009	Christopher Monfort – Murdered Seattle Police Officer and firebombed vehicles.
Dec 2008	Ruben Shumpert – Ex-convict joins al-Shabaab, killed in Somalia fighting.
Mar 2008	Earth Liberation Front (ELF) – Destroyed 4 Snohomish homes with arson fires.
Jul 2006	Naveed Afzal Haq – Seattle Jewish Federation shooting deemed 'Hate Crime'.
Dec 2005	Oussama Abdallah Kassir – Trainer at AQ terror training camp in Bly, Oregon.
Dec 2005	Michael Curtis Reynolds – Agreed to blow up Oil Pipelines in Idaho for AQ.
Nov 2005	Dominick Sergio Maldonado – Active Shooter and kidnap at Tacoma Mall.
Jun 2003	Paul Douglas Revak – U.S. Coast Guard facility bomb plot in Bellingham, WA.
Oct 2002	"Portland 7" – Attempt to join AQ and fight against U.S. forces in Afghanistan.
May 2001	ELF's Justin Solondz and Briane Waters – UW Horticulture Building Arson.
Dec 1999	Ahmed Ressam – LAX Millennium Bomb Plot; intercepted in Port Angeles, WA.

Probability of Future Events – It is impossible to provide a precise probability of future events of this type but the general consensus is anywhere from 1 to 10 years. The most likely tactics to be used are Active Shooter(s), Bombings (any variety), and Cyber Attacks. The least likely tactics to be used are Chemical, Biological, Radiological, and Nuclear (CBRN) Bombing/Attack and Hijacking/Skyjacking. Most likely targets are assessed to be Government Facilities, Commercial Facilities (Public Assembly, Retails, Entertainment and Media, etc), Transportation, and Military and Law Enforcement.

Jurisdictions at Greatest Risk – Generally, terrorists target densely populated or high profile areas, therefore any of the State's major urban areas could be considered at risk, as well as any of the State's higher profile critical infrastructure. King, Pierce, Snohomish, Clark, and Spokane counties have the highest population and critical infrastructure density in the State. However, the specific motivations of terrorist and violent extremists dictate target selection, thus any location in Washington has the potential to become a target.

The Hazard

Despite more than a decade of robust counterterrorism and homeland security efforts, forecasting potential terrorist targets and events has proven to be a difficult task—if not near impossible—at a national level, as well as, within Washington State. International terrorist organizations, independent terror cells, Homegrown Violent Extremists (HVEs), and 'Lone Wolf' violent extremists are all determinedly and concurrently employing efforts to cause harm to the U.S., its allies, and its interests. The sheer volume, evolving tactics, and chance indicators seen in historical acts of terrorism against the Homeland are primary reasons Washington State is including the 'Terror Threat' to its statewide Threat Mitigation Plans. This Terrorism Profile intends to outline, among other things, some of the risk factors which make Washington State a target-rich environment, and therein, identify critical focus areas for threat mitigation planning at the state and local levels.

Threat Definitions
The Federal Bureau of Investigation (FBI) defines **terrorism** as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objective". The definition continues to specify terrorism as either domestic or international, based upon the origin, base, and objectives of the terrorist organization.

"**Domestic Terrorism** involves groups or individuals who are based and operate entirely within the United States and Puerto Rico without foreign direction and whose acts are directed at elements of the United States Government or [its] population."[103] *(Examples: 1995 Oklahoma City bombing, 1996 Atlanta Centennial Olympic Park bombing, 2009 murder of George Tiller (late-term abortion physician), 2010 Hutaree Militia plots against Law Enforcement, 2010 Austin IRS plane attack.)*

"**International Terrorism** is the unlawful use of force or violence committed by a group or individual, who has some connection to a foreign power or whose activities transcend national boundaries, against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."[1] *(Examples: September 11 World Trade Center attacks, 2005 London Train bombings, 2009 Fort Hood shooting, 2010 Mumbai attacks, 2010 Time Square attempted bombing.)*

"**Cyberterrorism** is the convergence of cyberspace and terrorism. It refers to unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. [A cyberterrorism] attack should result in violence against persons or property, or at least cause enough harm to generate fear. Virtually initiated attacks which lead to the death or bodily injury, explosions, or severe economic loss can also be included in cyberterrorism-related activities. Attacks against elements of a government's critical infrastructure could also be classified as acts of cyberterrorism depending on the impact of such an event."[104] *(Examples: 2002 CIKR Digital Systems Site Casing, 2003 Ohio Nuclear Power Plant servers crashed by Slammer Worm, 2012 Al-Qa'ida calls for "Electronic Jihad" against U.S. CIKR.)*

A **Homegrown Violent Extremist (HVE)** is defined as "a person of any citizenship who has lived and/or operated primarily in the U.S. or its territories who advocates, is engaged in, or is preparing to engage in ideologically-motivated terrorist activities (including support to terrorism) in the furtherance of political,

social, or religious objectives promoted by a foreign terrorist organization (FTO), but is acting independently of direction by the FTO."[105] HVEs may assemble in groups, but typically act independently in attacks or other acts of violence. *(Examples: Hosam Smadi – Dallas Skyscraper plot, Umar Farouk Abdulmuttalab (aka Underwear Bomber) – Attempted bombing on Northwest Airlines flight on Christmas Day 2009, Farooque Ahmed – 2010 D.C. Metro plot, Khalid Aldawsari – 2011 plot to attack President G.W. Bush's Texas home, and others like this.)*

A **Lone Wolf** is defined as someone who commits or prepares for violent acts in support of some group, movement, or ideology, but does so alone, outside of any command structure. They are simply an HVE, International, or Domestic Terrorist acting alone. A Lone Wolf may be motivated by any terrorist or violent extremist ideology, and may have even communicated at some point with others about the ideology, but decided to act alone. *(Examples: "Unibomber" Theodore Kaczynski, Eric Rudolph - 1996 Olympic Park attacks, Joseph Andrew Stack - 2010 Austin IRS Plane attack.)*

A **Weapon of Mass Destruction (WMD)** is defined by the FBI as "any explosive or incendiary device, as defined in Title 18 USC, Section 921, as a bomb, grenade rocket, missile, mine, or other device with a charge of more than four ounces. A WMD is further defined as "any weapon designed or intended to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals or their precursors."[106] *(Examples: 2001 Anthrax attacks, 2002 Dirty Bomb plot, 2009 plan to shoot down NY National Guard planes with stinger missiles.)*

Previous Occurrences

While Washington State is historically seasoned with violent extremists, there were less than a dozen major terrorist events in the Northwest prior to September 11, 2001. One of the first major terrorism cases in the Northwest was the Rajneeshee bio-terror attack in February 1984, where members of the Rajneesh [cult] intentionally contaminated local restaurants with salmonella in The Dalles, Oregon. Other notorious terror cases include the arrest of Ahmed Ressam, the "Millennium Bomber," in December 1999, and the Earth Liberation Front (ELF) firebombing of University of Washington's (UW) Horticulture Center in May 2001.[107]

Figure 16-2: The skeleton of what was the UW Center for Urban Horticulture building after various ELF members

Since 2001, there have been more than 20 terrorism and violent extremism cases in or with connections to the Northwest (Washington, Oregon, Idaho). Once viewed as an external problem, the U.S. has been subjected to a growing number of homegrown and domestic terrorism events, making it more commonplace than ever before. Though terrorism is not new, the vast number of methods in which an attack can occur has seemingly expanded due to an increased interest. A plot can include multiple combinations of tactic type, weapon(s) type, location, target type, and number of operators. Increased security measures over time have forced terrorist and violent extremists to become more innovative in their attempts to concoct the most effective and lethal combinations of attack components while maintaining the ability to go undetected until the time of the operation.

Attacks resulting from international terrorism, domestic terrorism, and significant criminal activity can be manifested in numerous ways. The following attack categories are the most likely methods in which these threats would materialize. Included are notable local incidents for that category.

Active Shooters (Single): An individual who participates in a random or systematic shooting spree demonstrating their intent to continuously harm or kill others. These situations are dynamic and evolve rapidly, demanding immediate deployment of law enforcement resources to stop the shooting and limit harm or loss of life to innocent victims.[108]

On May 30, 2012, Ian Stawicki [USPERS] opened fire at a small Seattle café, killing two patrons. He then fled the scene and headed to first Hill, where he preceded to hijack a car, killing the woman occupying it. The spree didn't end until nearly five hours later when, confronted by police in West Seattle, he dropped to his knees and shot himself in the head.[109]

On July 28, 2006, Naveed Haq [USPERS] was arrested for shooting six women, one fatally, at the Jewish Federation of Greater Seattle. The shooting came a day after the FBI had warned Jewish organizations nationwide to be on alert after Hezbollah leaders in Lebanon urged to bring the war raging in the Middle East to the West. Open sources indicate Haq was not affiliated with any group, but rather had a personal antagonism towards Jews.[110, 111]

Active Shooters (Multiple): A group who participates in a random or systematic shooting spree demonstrating their intent to continuously harm or kill others. These situations are dynamic and evolve rapidly, demanding immediate deployment of law enforcement resources to stop the shooting and limit harm or loss of life to innocent victims.[112]

On June 22, 2011, Abu Khalid Abdul-Latif [USPERS] and Walli Mujahidh [USPERS] were arrested and charged with conspiracy after planning to attack the Military Entrance Processing Station (MEPS) in Seattle with machine guns and grenades after previously planning, but discounting, an attack at Joint Base Lewis McChord (JBLM). According to FBI investigators, "Abdul-Latif said that 'jihad' in America should be a 'physical jihad,' and not just 'media jihad,' expressing his view that it was necessary to take action rather than just talk." Abdul-Latif, an ex-con with a robbery and assault record, faces a life sentence, while his co-defendant, Mujahidh, faces 27 to 32 years in federal prison.[113]

On October 4, 2002, seven individuals were arrested for attempting to join Al-Qa'ida in their fight against the U.S. military and coalition forces in Afghanistan. Later coined the "Portland 7," they were all named in the 15-count indictment that included charges of "conspiracy to levy war against the United States, conspiracy to provide material support and resources to al-Qa'ida, conspiracy to contribute services to al-Qa'ida and the Taliban, conspiracy to possess and discharge firearms in furtherance of crimes of violence, possessing firearms in furtherance of crimes of violence and money laundering."[114]

Bombings (IED/SVIED): A device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. It is typically devised from non-military components; *Improvised Explosive Devices (IED) or Suicide-Vest Improvised Explosive Device (SVIED).*[115]

On January 17, 2011, Kevin Harpham [USPERS] placed a remote-controlled backpack improvised explosive device (IED) at a park bench near the march route on the morning of the Martin Luther King Jr. Day Parade in Spokane, WA.[116]

On June 9, 2003, Paul Douglas Revak [USPERS], a [then] 20-year old self-proclaimed Anarchist, was arrested for planning to bomb a U.S. Coast Guard facility in Bellingham, WA. He attempted to precipitate a revolution in the U.S. and discussed targeting several military installations. He was arrested when he negotiated with an undercover FBI agent for the purchase of explosive device components. Charged with threatening to use a WMD, he was only sentenced five years probation under a plea agreement.[117]

On December 14, 1999, Ahmed Ressam, a 32-year old Algerian living in Montreal, Canada, was arrested by U.S. Customs agents while trying to enter the U.S. from Victoria, British Columbia on a ferry to Port Angeles, WA. Ressam was attempting to enter the U.S. while toting 240-pounds of homemade explosives in the trunk of his rented vehicle. He was charged with smuggling explosive material into the United States. Initially, law enforcement officials investigated the possibility of a terrorist bombing during the year 2000 New Year's Eve celebration at the Seattle Space Needle, since an event of this kind normally draws thousands of people in celebration, but later determined the explosives were meant for a bombing at the Los Angeles International Airport that was to happen on New Year's Eve.[118]

Bombing (VBIED): Vehicle-Borne Improvised Explosive Devices (VBIED) use explosives to weaponize cars, trucks and even motorcycles; in assassinations aimed at killing a specific individual(s) and in attacks designed to achieve mass destruction to people and property. These can be either set to detonate remotely or by some type of trigger.[119]

On November 26, 2010, federal law enforcement officials arrested Mohamed Osman Mohamud [USPERS], 19, and accused him of plotting to bomb Pioneer Courthouse Square in Portland, OR during a Christmas tree-lighting ceremony. An estimated 10,000 people were at the ceremony during the attempt. Mohamud, born in Somalia, was charged with trying to use a weapon of mass destruction. He thought he was detonating a car bomb at the packed ceremony after federal agents said that they had spent nearly six months setting up a sting operation. Mohamud had reportedly become a radicalized, violent Islamic extremist while living and studying in Oregon.[120]

Arson and Firebombing: Any willful or malicious firebombing, burning, or attempt to burn, with the intent to defraud, harm or kill others, or destroy property; including a dwelling house, public building, motor vehicle or aircraft, personal property, etc.[121]

On October 22, 2009, Christopher Monfort [USPERS] emplaced improvised incendiary explosive devices (IIED) under two patrol vehicles parked in a maintenance yard as part of his violent campaign against the Seattle Police Department. The bombs designed to target and kill police, firefighters, and medics who arrived to battle the arson blaze. Monfort is also responsible for the murder of a police officer a week later (see more in 'Murder/Assassination' section below).[122]

On May 21, 2001, Justin Solondz [USPERS], Briana Waters [USPERS], and three other members of the environmental extremist group Earth Liberation Front (ELF) placed a homemade incendiary device in a filing cabinet in the University of Washington Horticulture Center, causing approximately $4 million in damages. Solondz and Waters have been the only two sentenced so far.[123]

Murder / Assassination: The killing of a selected victim, usually by bombing, small arms, or poison; typically for a political, religious, or social-psychological effect.[124]

On November 29, 2009, Maurice Clemmons [USPERS] walked into a Forza Coffee shop where he shot and killed four Lakewood, WA police officers who were preparing to start their day shifts. Clemmons was later shot and killed by a police officer after a two-day manhunt. He had a violent past that included multiple run-ins with law enforcement and possible mental instability that influenced his hatred towards law enforcement officers.[125]

On October 31, 2009, Christopher Monfort [USPERS] shot and killed an officer on duty in the Central District of Seattle, culminating his politically-driven, violent war against the Seattle Police Department. The officer was seated in a parked patrol car with another officer discussing a traffic stop when Monfort stopped his vehicle alongside the patrol car, opened fire on the two officers, then fled the scene. One week later, Monfort was apprehended and seriously wounded after being shot by police officers in Tukwila.[126] He is awaiting trial.

Other Explosives or Weapons: The calculated use of explosives or other weapon type in order to attain goals that are political or religious or ideological in nature; terror attack using weapon type not already covered.[127]

On September 8, 2011, Michael McCright [USPERS] was arrested and charged with second-degree assault after a July 2011 incident in which he swerved his privately owned vehicle at a government vehicle occupied by two Marines north of Seattle. McCright allegedly has ties to Abu Khalid Abdul-Latif.[128]

CBRN Attack / Bomb: Weaponized chemical, biological, radiological and nuclear materials that are intentionally used in criminal acts with the intent to harm or kill others; acts may include the deliberate dumping or release of hazardous materials, poisoning of one or more individuals, or contamination of food, livestock and crops.[129]

See reference above to Kevin Harpham [USPERS] and the Martin Luther King Day Parade bomb attempt, in Spokane, WA. The backpack he used had been cut to allow the insertion of the wooden-framed, 6-inch steel pipe loaded with 128-quarter ounce weights that were coated with rat poison to act as an anti-clotting agent.[130]

Kidnappings and Hostage-Takings: The overt seizure of a facility or location and the taking of hostages; used to establish a bargaining position and to elicit publicity; for the purpose of gaining money, release of jailed comrades, and publicity for an extended period.[131]

See reference above to Naveed Haq [USPERS] shooting at the Jewish Federation of Greater Seattle. To gain access to the building, he held a 14-year old girl hostage at gunpoint. Once they were in the building, the girl ran and hid, and then Haq proceeded to shoot.[132]

Support to Terrorism: Anyone who provides material support or resources or conceals or disguises the nature, location, source, or ownership of material support or resources, knowing or intending that they are to be used in preparation for, or in carrying out, an act of terrorism or violent extremism.[133]

On October 27, 2012, Abdisalan Hussein Ali [USPERS], a 22-year old who was born in Somalia, but raised in Seattle and Minnesota, was the third American killed as an Al-Shabaab suicide bomber in Mogadishu. He was a pre-med student before purportedly being recruited into al-Shabaab and travelling to Somalia in 2008.[134]

On May 9, 2011, Joseph Brice [USPERS], a 21-year old from Clarkston, WA, was arrested for assembling, practicing, and detonating homemade IEDs. He created a YouTube channel called Strength of Allah, to which he posted demonstrations of the IEDs and advertised his willingness to build them for others; thus, the charges of support to terrorism.

In April 2009, Abdifatah Yusuf Isse [USPERS] pled guilty to training with and providing material support to al-Shabaab, beginning in December 2007. A prior economics major at Eastern Washington University, Isse also admittedly had contact with Shirwa Ahmed, the first known American suicide bomber, while he was being trained in Somalia.[135]

On December 12, 2008, Ruben Shumpert [USPERS], aka Amir Abdul Muhaimeen, was reportedly killed in Somalia while fighting for al-Shabaab. He was under investigation by the FBI for distributing jihadi video recordings and providing weapons training while living in Seattle before fleeing the U.S. with the help of local Somali Islamic extremists.[136]

On December 11, 2005, Oussama Abdallah Kassir was arrested for serving as a trainer, alongside founder James Ujaama, at an Al-Qa'ida affiliated terror training camp in Bly, Oregon.[137]

Hijacking and Skyjacking: The seizure by force of an aircraft, surface vehicle, vessel, its passengers, and/or its cargo; often creates a mobile, hostage barricade situation.[138]

While there has been no hijacking or skyjacking incidents in Washington State, SeaTac International Airport is one of Seattle's most valuable and vulnerable assets. Additionally, Washington is home to numerous cruise ship terminals and the nation's largest ferry fleet. A successful maritime attack would have a significant economic and psychological impact.

In 2004, an AQ member in U.S. custody told interrogators that the original 9/11 plan called for terrorists to seize 10 planes and attack targets on both coasts, including a black-glass skyscraper that towers over downtown Seattle.[139]

Cyber Attack: A deliberate exploitation, disruption, or destruction of information/data, computer systems, computer programs, technology-dependent enterprises and networks through the use of malicious code to alter computer code, logic or data; aka Computer Network Attack (CNA).[140]

In October of 2012, actors claiming affiliation with the hacktivist group Anonymous threatened to launch "Operation Grand Jury Resisters" in response to the treatment of suspects implicated in federal crimes that occurred during May Day activities in Seattle. Online personas specifically cited the City of Seattle's www.seattle.gov public website, the FBI, and the district's U.S. Attorney's Office as targets for cyber attacks.

Maritime Attack: The undertaking of criminal acts and activities within the maritime environment, using or against vessels or fixed platforms at sea or in port, or against any one of their passengers or personnel, against coastal facilities or settlements, including tourist resorts, port areas and port towns or cities.[141]

Washington State has one of the sixth largest maritime ports in the U.S. and houses the nation's largest ferry fleet, servicing approximately 22.3 million riders per year.[142] Local cruise ship terminals also host over 200 cruise ships annually and are responsible for generating over $2 million into the local economy.

While there have been no terror incidents within the State's maritime sector, a successful maritime attack locally would have a significant economic and psychological impact.

Probability of Future Events

Historically, terrorists and violent extremists have demonstrated their continued desire to commit acts of terrorism in highly populated or high profile areas. Numerous critical infrastructures and public events have been the targets of foiled terror plots in Washington State, as well. The map below displays the population densities of counties within Washington. Highly populated counties tend to have a heavier infrastructure base to support a large population and, therefore, typically have more potential targets for terrorists and violent extremists seeking to inflict harm on these types of systems. This is not to say that these are the only target-rich environments. For example, intelligence reporting indicates terrorists' interests in targeting infrastructure such as dams, food supplies, or cyber infrastructures; which can be located in sparsely populated areas or are not centralized to one specific locale.

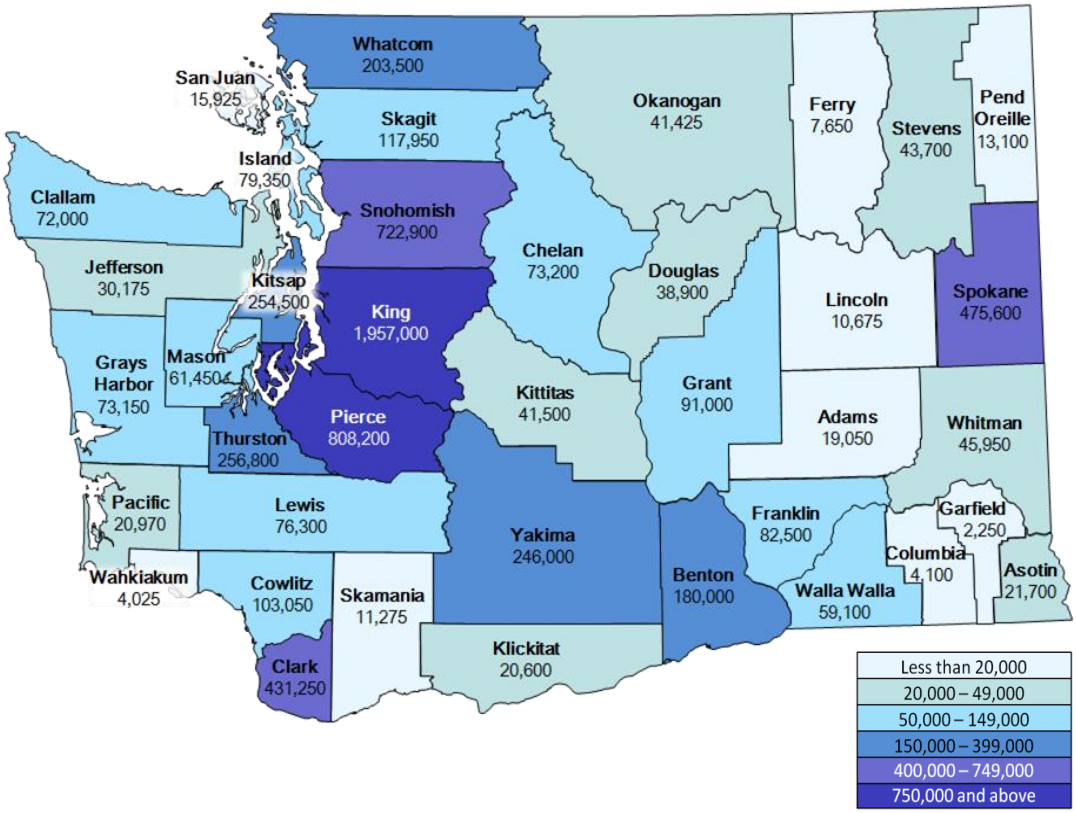

Figure 39: Map of Washington Population Densities by County. Densities are based on April 2012 county population estimates from the Washington State Office of Financial Management. **Click here for source* data in Excel.

Communities vulnerable to terrorist incidents are those that have high visibility, or are internationally known (i.e. Seattle), and those communities containing highly visible targets. The Department of Homeland Security has identified 18 critical infrastructure and key resource (CIKR) sectors which covers the gamut of facilities, sites, routes, and systems which are most vulnerable to acts of violence, intrusion, or destruction. Additionally, special events or sites attracting large gatherings tend to be the most lucrative targets due to the high volumes of potential victims, and become even more appealing during visits by high profile personalities and dignitaries. Examples of high impact targets within the 18 CIKR sectors include:

- Commercial buildings (stadiums, concert venues, convention centers, theatres, parks, shopping malls, casinos, etc.)
- Cyber / Information Technology (system networks, power grids, communication industry, etc.)
- Special events (parades, religious services, festivals, other planned celebrations, etc.)
- Government (courthouses, schools, universities, hospitals, etc.)
- Law Enforcement / Emergency Services (first responders and all law enforcement facilities, equipment, personnel, etc.)
- Defense (military bases, facilities, airfields, equipment, personnel, national laboratories, etc.)
- Transportation (airports, bridges, ferries, interstate highways, passenger rail, tunnels, seaports, hazardous materials pipelines, etc.)
- Financial Institutions / Banks
- Historical landmarks, monuments, museums, and other iconic sites
- Dams, water reservoirs, and the power distribution network

Current Overwatch

The FBI is the lead agency in the U.S. for all matters concerning terrorism and violent extremism. Therefore, the current mitigation plan for such in Washington State mirrors that of the FBI's national-level procedures and guidelines. Specific outreach and coordination in response to a terror incident, while mostly predetermined, will be customized for the incident and dictated to response partners at that time.

Currently, the Seattle Field Office of the FBI has various tasks forces operating to address terrorism matters, including:

- Puget Sound Joint Terrorism Task Force (PS-JTTF)
- Puget Sound Counterterrorism Working Group (PS-CTWG)
- Inland Northwest Regional Terrorism Task Force (IN-RTTF)
- Northwest Cyber Crime Task Force (NW-CCTF)

These FBI task forces work, in conjunction with local and state law enforcement agencies, to share information and to conduct terrorism investigations. Key partners with the FBI's counterterrorism efforts in the Northwest are the officers, investigators, and analysts from the Washington State Fusion Center, Internal Revenue Service, Washington State Patrol, Seattle Police Department, U.S. Coast Guard, Customs and Border Protection, and various other intelligence and law enforcement agencies. In

addition to these task forces and partnerships, counterterrorism remains the FBI's highest priority and can levy agents and analysts from around the nation to mitigate these threats.

Assessment

Acts of terrorism and violent extremism are the most challenging of all hazards to face. While hurricanes, earthquakes, and other natural disasters can be scientifically forecasted, tracked, and somewhat safeguarded against, acts of terrorism are far less predictable. Furthermore, identifying what measures to take once a threat is detected or an attack has already occurred is more of an art than science. The initial unpredictability and the difficulties in conducting response planning for successful attacks are all completely dependent upon the specific combination of—among dozens of other factors—the numbers, skills, training, motivations, extent of radicalization, and abilities of the operators combined with the time of attack, specific location, weapon type(s), tactics, intended target(s), barriers, and numbers of potential victims. Dozens of factors, equating to thousands of possible combinations, equals a seemingly infinite number of attack scenarios that could play out. Take for example, the 2008 Mumbai Attacks. This four-day long event included 11 coordinated hostage-takings, shootings, arson, and bombings across the city. It was conducted using 10 operators, who traveled from Pakistan to Mumbai India via boat. The targets expanded over a wide range of CIKR sectors and included a world heritage site, railway station, café, taxis, hotels, Jewish Center, law enforcement, and the local populace. A total of 164 people were killed, more than 300 were wounded, and damage to the city was estimated to be [equivalent to] almost $20 million USD.[143] Additionally, consider the Fort Hood shooting, where a U.S. Army soldier, Nidal Hasan [USPERS], began a deadly shooting spree after being radicalized with the help of Anwar al-Awlaki [USPERS]. This attack was conducted by one man, with a handgun, while in his military uniform. He was able to singlehandedly kill 13 people and wound 29 others. Property damage was slight, but the psychosocial effects felt by U.S. citizens were likely equivalent to that of the Mumbai Attacks.

The weighty differences in attack types in just those two examples are reasons why man-made threats, unless detected and thwarted early, are difficult to plan for and attempt to mitigate. Over the past 12 years, the U.S. Intelligence Community has worked extensively to collect on potential threats, thwart plots, and implement security measures in order to deny terrorists or violent extremists opportunities to cause harm within the Homeland. The undying will and evolving persistence of the enemy necessitates we continue to develop effective information sharing conduits, conduct collective mitigation planning and exercises, and look to the statistical enumeration of historical events as foundations for deterring future attacks.

Jurisdictions Most Threatened and Vulnerable to Terrorism Hazards

This was not determined.

Potential Climate Change Impacts

Changes in climate would most likely have very little impact (if any) on a terrorist or violent extremist attack (unless using arson or CBRN tactics).

At Risk State Facilities

This was not determined.

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Urban Fire

 Urban Fire	**Frequency**	50+ yrs	10-50 yrs	1-10 yrs	Annually
	People	<1,000	1,000-10,000	10,000-50,000	50,000+
	Economy	1% GDP	1-2% GDP	2-3% GDP	3%+ GDP
	Environment	<10%	10-15%	15%-20%	20%+
	Property	<$100M	$100M-$500M	$500M-$1B	$1B+
	Hazard scale	< Low to High >			

Risk Level

Frequency – Fires in urban areas of Washington occur annually.
People – An urban fire affecting 1,000 people or more is highly unlikely.
Economy – The economy of Washington is not likely to be impacted by a fire in an urban area to the point that it meets the minimum threshold for this category.
Environment – While an urban fire can affect habitat and species, the probability that the fire will destroy 10% of a habitat or kill 10% of a species is considered highly unlikely.
Property – According to the "2010 Fire in Washington", report prepared by the Office of the State Fire Marshal, total property and content loss due to fire was estimated to be approximately $215 million dollars.

HIVA Risk Classification for Urban Fire is 4D or Mitigation to Reduce Risk is Optional.

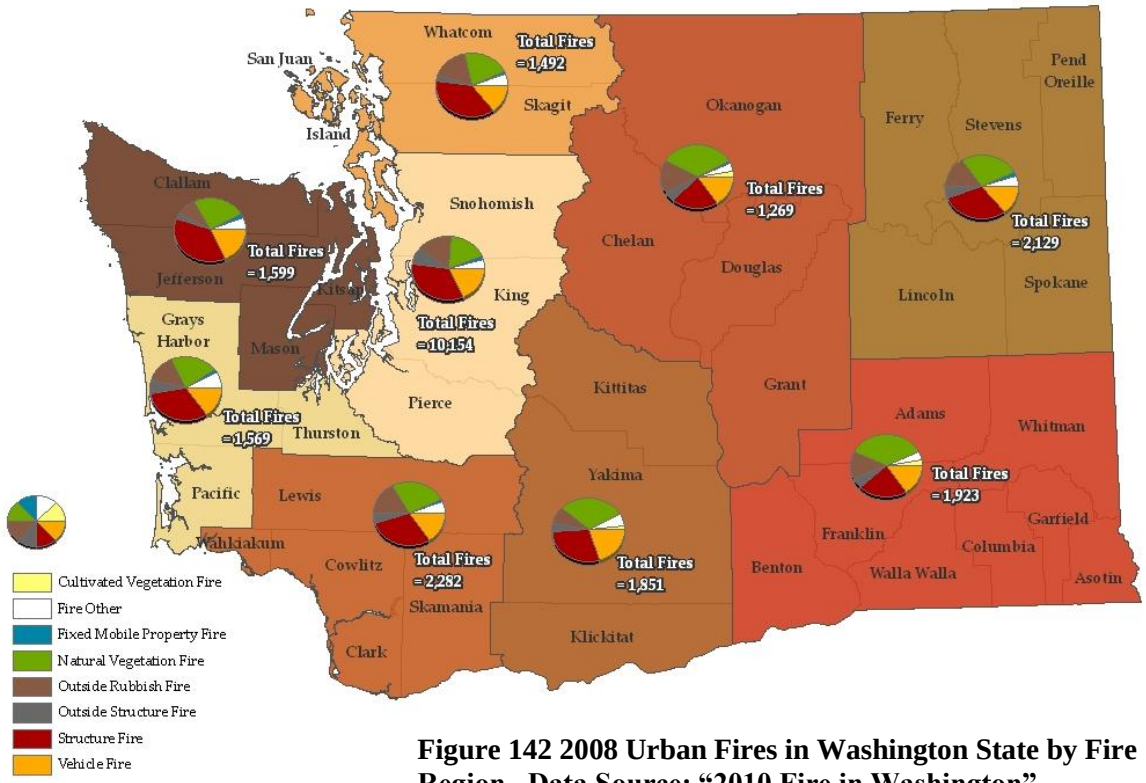

Figure 142 2008 Urban Fires in Washington State by Fire Region. Data Source: "2010 Fire in Washington"

The Hazard[144]

Urban fires are classified as "uncontrolled burning in a residence or building from natural, human, or technical causes". These fires have a potential to spread to adjoining structures. Local city and county fire departments are tasked with the response and control of urban fires.

The Washington State Office of State Fire Marshall suspended publishing annual fire reports for Washington State in 2011 because of budget cuts. Consequently, the last available report is from the 2010 calendar year. Revised Code of Washington (RCW) 43.44.060 states that fire agencies are required to submit fire incidents to the Office of State Fire Marshall in accordance with the National Fire Incident Reporting System (NFIRS). In 2010, participation decreased 2% compared to the previous year with 411 out of 488 fire agencies providing information.

Nonetheless, in 2010, fire departments in Washington responded to nearly 615,000 calls with over 20,000 of these due to urban fire. These fire incidents caused an estimated $215 million dollars in damaged property and possession loss. Further, it is estimated that the indirect costs of urban fires can be 8 to 10 times greater for "temporary lodging, psychological damage, lost business, medical expenses, and others" than suppression, possessions and damage costs.

Figure 143 Incident Type Table

2010 Incident Type Category Summary (Sorted by Dollar Loss)

Incident Type Category	Total Number of Incidents	% of Total Incidents	Total Property and Content Loss	% of Total Loss
Fire	20,019	3.3%	$215,429,333	95.8%
Structure Fires (including confined fires)	*6,784*	*1.1%*	*$176,043,129*	*78.3%*
Natural Vegetation Fires	*4,202*	*0.7%*	*$18,842,637*	*8.4%*
Vehicle Fires (Mobile Properties)	*3,496*	*0.6%*	*$15,973,245*	*7.1%*
Fixed Mobile Property Fires	*261*	*0.0%*	*$2,811,031*	*1.2%*
Fire, Other	*1,133*	*0.2%*	*$1,060,274*	*0.5%*
Cultivated Vegetation Fires	*172*	*0.0%*	*$300,775*	*0.1%*
Outside Storage & Equipment Fires	*1,032*	*0.2%*	*$243,259*	*0.1%*
Outside Rubbish Fires	*2,939*	*0.5%*	*$154,983*	*0.1%*
Overpressure Rupture, Explosion, Overheat (No Fire)	1,189	0.2%	$5,070,504	2.3%
Rescue and Emergency Medical Service	443,008	72.0%	$2,498,370	1.1%
Service Calls	40,650	6.6%	$715,000	0.3%
Hazardous Conditions (No Fire)	11,785	1.9%	$573,505	0.3%
Other Types of Incidents	6,572	1.1%	$283,500	0.1%
False Alarms & False Calls	40,284	6.5%	$281,947	0.1%
Unintentional False Fire Protection System Activation	*20,752*	*3.4%*	*$203,230*	*0.1%*
Fire Protection System Malfunction	*11,136*	*1.8%*	*$78,002*	*0.0%*
Malicious or Mischievous False Alarm	*8,396*	*1.4%*	*$715*	*0.0%*
Good Intent Calls	51,032	8.3%	$37,820	0.0%
Severe Weather & Natural Disaster	913	0.1%	$7,350	0.0%
Undetermined Type of Incident	16	0.0%	$0	0.0%
Grand Total	615,468	100.0%	$224,897,329	100.0%

In 2010, one structure fire was reported every 1.3 hours with a resulting dollar loss of over $590,000 a day, about $25,000 an hour or $410 every minute. Fire statistics in Washington State for 2010 are summarized in the table above.

In 2010, the number of fires reported decreased 20% compared to the previous year but fewer fire agencies were reporting incidents. Over the past five years, structure fires were the leading fire incident type reported. Washington's residential property ranked second in number of fire incidents, but number one in dollar loss. Statewide, structure fires average approximately 1.2 fires per thousand people. Structure fires include buildings or other types of structures, and firers confined to non-combustible containers such as food son stoves, chimneys or flues, boilers, trash receptacles, or commercial compactors.

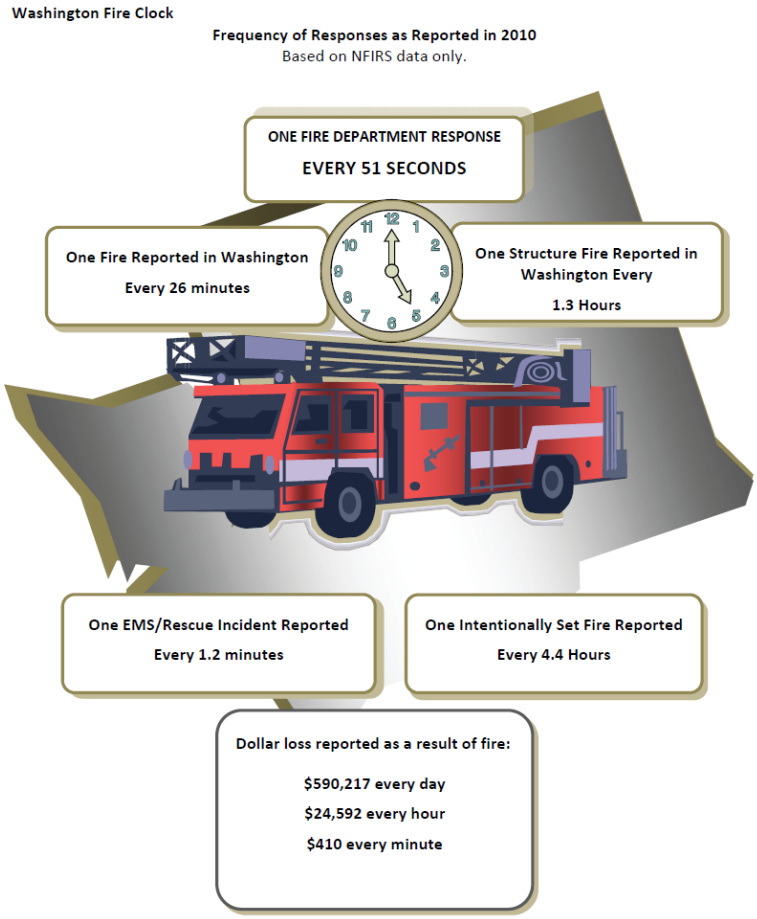

Figure 144 Frequency of WA Fire Department Responses in 2010 (Based on NFIRS data only)

http://www.wsp.wa.gov/fire/firemars.htm

While the dollar amount lost to fire is considerably high, the loss of life due to fire in Washington remains lower than the national average. 289 people lost their lives in fires within our state from 2006-2010. Yet, according to the last available national statistics from 2007, the fire fatality rate for the United States is 13.2 per million people. Washington State's rate was 10.0 fire deaths per million people and it ranked 14th lowest in the nation.

Previous Occurrences[145]

Washington has had two notable large urban fires in its history, both occuring in 1889. The Great Seattle Fire occurred on June 6, 1889 and destroyed the entire central business district of Seattle. This fire burned the majority of 29 city blocks, including the central business district, four of the city's piers, and the railroad terminal. Only one person is known to have died in this fire and total losses were estimated around $20 million. The Spokane Fire occurred on August 4, 1889 and destroyed most of what was then downtown Spokane. Other notable historic fires include a fire in the Ozark Hotel in Seattle on March 21, 1970 that killed 19 people and the Great Ellensburg Fire of July 4, 1889 that destroyed 200 Victorian homes and 10 blocks of businesses.

With the advent of more modern fire fighting technology, zoning and building codes that mitigation conflagration, and a skilled professional class of firefighters, we are unlikely to experience a fire of catastrophic magnitude again. However recent urban fires continue to kill people and destroy millions of dollars in property.

Probability of Future Events[146]

Zoning, building codes, building materials, trained firefighters, specialized apparatus, and early detection technology has mitigated urban fires so that they no longer decimate whole cities like in 1889. Sustained mitigation efforts over the past 100 years has reduced the risk of an urban conflagration fire to nearly nil but urban fires continue to kill people and destroy millions of dollars in property each year. The hazard is still real whether its acts of negligence, chance occurrences, arsonists, terrorism, riots, warfare, or an earthquake. Urban fires will still happen with sometimes tragic consequences.

Structure fires represented 31% of the total urban fires reported in 2006-2010. Among these fires, 27% were caused by operating equipment such as sparks, embers, or flames from space heaters, stoves, etc, or other conductive or radiated heat sources and 14% were caused by open flame, matches and lighters, flares, fuses and torches, candles and smoking material (cigars, cigarettes, pipes, etc). Hot or smoldering objects were the third leading known heat source category such as molten materials, hot embers or ash, heat from friction, etc.

Occupancy Categories	Total	% of Total
Single Family Dwellings	27	40.3%
Multi-Family Dwellings	18	26.9%
Oil Refinery	7	10.4%
Recreational Vehicle/Travel Trailer	6	9.0%
Outside (including tents)	5	7.5%
Detached Garage or Shed	2	3.0%
Motor Vehicle	2	3.0%
Grand Total	67	100.0%

Figure 145 Places Fire Fatalities Occurred in 2010

http://www.wsp.wa.gov/fire/firemars.htm

Fatal fires most frequently occur in places where people live or sleep. In 2010, approximately 67% of the fire fatalities occurred in residential occupancies. Single-family dwellings alone accounted for 40% of the reported fire fatalities, of which nearly a quarter of those deaths were in mobile homes. Multi-

family dwellings accounted for 27% of the fire related deaths in Washington in 2010. Smoking related fires resulted in 22% of the fire fatalities in 2010. Explosions, electrical-related fires, and fires caused by cooking, home heating, and candles were the other leading causes for fire fatalities.

The leading areas of origin reported between 2006 and 2010 were those fires starting in outside areas (32%) and in vehicle areas (22%). Fires that started in functional areas (16%) resulted in the greatest amount of dollar loss to property and contents at over $242 million. Functional areas include bedrooms, dining or eating areas, kitchens, bathrooms, laundry rooms, office spaces, etc. Fires that started in structural areas (7%) such as crawl spaces, balconies or enclosed porches, attics, wall assemblies and surfaces, roof surfaces, and awnings accounted for more than $235 million in losses for the period 2006 through 2010. Total dollar loss for this period from all areas of origin was $1.138 billion.

The use of fire protection devices such as fire sprinklers and smoke detectors can greatly reduce the loss from a fire. Approximately 66% of the fire fatalities occurred where no operable smoke alarms or detectors were reported. Seventeen fire fatalities occurred in areas where smoke alarms or detectors were present and operational but human factors such as the person was asleep, under the influence of drugs or alcohol, or had physical or mental impairment, may have contributed to the individual not escaping the fire. None of the fire fatalities in 2010 occurred in buildings equipped with fire sprinklers.

Figure 146 Fire Causes

Cause Category	2006	2007	2008	2009	2010	5-Year Total	5-Year % of Total
Smoking	14	9	4	10	15	52	18.0%
Electrical Appliance/Distribution	9	6	5	8	4	32	11.1%
Intentionally Set	3	6	7	6	0	22	7.6%
Vehicle-Related	7	4	4	3	0	18	6.2%
Cooking	5	2	5	2	2	16	5.5%
Under Investigation	1	7	2	4	1	15	5.2%
Home Heating	6	3	3	1	2	15	5.2%
Candle	5	2	1	0	2	10	3.5%
Explosion	0	0	0	0	7	7	2.4%
Flammable Vapors Ignited	0	1	1	0	2	4	1.4%
Drug Manufacturing/Lab	0	0	0	3	0	3	1.0%
Portable Gas Powered Heating Appliance	0	0	0	3	0	3	1.0%
Child with access to ignition device	2	0	0	0	0	2	0.7%
Vehicle Collision	0	0	0	0	1	1	0.3%
Gas Stove - Combustibles Too Close to Heat Source	0	0	0	1	0	1	0.3%
Camp Fire	0	0	0	1	0	1	0.3%
Outside Fire Pit	0	0	1	0	0	1	0.3%
Cutting Torch	0	0	0	1	0	1	0.3%
Portable Propane Heater	0	0	0	0	1	1	0.3%
Lighter	0	0	0	1	0	1	0.3%
Oil Lamp	0	1	0	0	0	1	0.3%
Over Heated Vehicle Exhaust	0	0	0	1	0	1	0.3%
Open Flame Device	0	1	0	0	0	1	0.3%
Tire Friction	0	0	0	0	1	1	0.3%
Open Flame	0	0	0	0	1	1	0.3%
Bricks on Gas Range	1	0	0	0	0	1	0.3%
Generator too close to combustibles	1	0	0	0	0	1	0.3%
Undetermined	13	9	12	14	28	76	26.3%
Grand Total	67	51	45	59	67	289	100.0%

In conclusion, urban fires in Washington occur in the places where people feel the most safety and security, their own homes. Fire education can help reduce fires in homes and make people more aware

of potentially dangerous situations. These programs can be accessed through local fire departments, community centers, and are part of some public school curriculums. With the proper use of smoke detectors and fire suppression systems loss of life due to urban fire can be greatly reduced. Human factors contributing to fires in the home can be reduced by operating heating equipment per the manufacturer's safety precautions, placing a fire extinguisher in the kitchen near cooking equipment, and smoking in areas of the home where combustible material is less abundant.

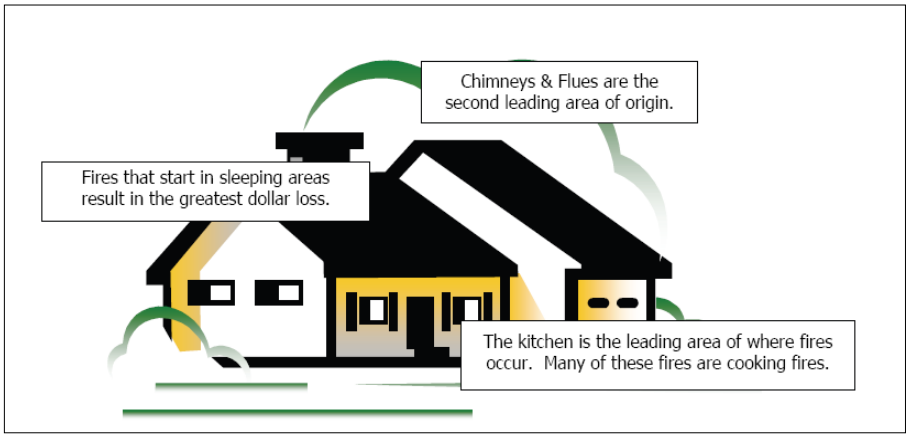

Figure 147 Places Where Home Fires in Washington Most Frequently Occur

Jurisdictions Most Threatened and Vulnerable to Urban Fire

In Washington State, 11 of the 39 counties have populations of over 100,000, representing 83% of the state's population. In 2010, approximately 86% of the incidents and 74% of the dollar loss reported as a result of fire occurred in the most densely populated counties.

Additionally, when the weather turns cold in Washington State, fire fatalities tend to increase as people stay inside where the risk is higher. December 2009 was the deadliest month in the past five years with 19 fire deaths while August 2007 was the only month in the past five years with zero fire fatalities.

Potential Climate Change Impacts[147, 148]

With the advent of climate change coming into worldwide focus; it is necessary to take into account the potential effects this emerging climate crisis may have on the dangers associated with urban fires. The research done so far indicates the potential for unusual or more frequent heavy rainfall and flooding is greater is some areas while the potential for drought is predicted in other areas. Landslide frequency is correlated with heavy rainfall and flooding events.

Recognizing Washington's vulnerability to climate impacts, the Legislature and Governor Chris Gregoire directed state agencies in 2009 to develop an integrated climate change response strategy to help state, tribal, and local governments, public and private organizations, businesses, and individuals prepare. The state Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Health, Natural Resources and Transportation worked with a broad range of interested parties to develop recommendations that form

the basis for a report by the Department of Ecology: *Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy*.

Over the next 50 - 100 years, the potential exists for significant climate change impacts on Washington's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts could potentially include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Therefore, climate change has the potential to impact the occurrence and intensity of natural disasters, potentially leading to additional loss of life and significant economic losses. Recognizing the global, regional, and local implications of climate change, Washington State has shown great leadership in addressing mitigation through the reduction of greenhouse gases.

At-Risk State Agency Facilities

The number of state facilities at risk to Urban Fire has not been determined.

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